TRANSLATING POLICY INTO PRACTICE: ASPECTS OF LEARNER-CENTRED CLASSROOM PRACTICES IN MATHEMATICS IN NAMIBIA SECONDARY SCHOOLS

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A thesis submitted in fulfillment of the requirements for the degree of Philosophiae Doctor (PhD) in the Faculty of Education, University of the Western Cape.

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KEY WORDS/TERMS

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ABSTRACT

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Philosophiae Doctor (PhD) thesis, Faculty of Education, University of the Western Cape.

The educational reform (1986-1995) in Namibia proposed pedagogical changes in the classrooms, namely the introduction of Learner-Centred approaches. To advocate and promote this new reform, several projects such as, the Integrated Teacher Training Programme (ITTP), the In-service Training Assistance for Namibian Teachers (INSTANT) and the Basic Education Teacher Diploma (BETD) were introduced. These programmes aimed for the improvement and for quality education in Namibian schools. Having been in-serviced in the approach of Learner-Centred Education, Secondary school teachers continue experiencing problems in implementing Learner-Centred approaches. Kamupingene (1998) reports that, Namibia is still experiencing problems with the implementation of Learner-Centred approaches despite all the attempts made to implement this approach smoothly. That is, several teachers in Namibia are experiencing problems with the implementation of Learner-Centred Education.

This study is guided by theories about educational policy implementation and their implications for teaching. These theories underline the notion that educational reform is a 'progress' and it

comes in cycles. According to Tyack and Cuban (1995), the first cycle (policy talk) is for diagnosing problems and for advocacy of solutions. It is followed by 'policy action'; then actual implementation of the plan. The implications for these theories therefore imply that teachers play an important role in any educational reform and as such should be involved in any decision-making and policy implementation in order to make any change in education a worthwhile process (Fullan, 2001; Helsby, 1999; Tyack and Cuban, 1995). This study focused on the implementation of the policy document '*Towards education for All: A development brief for education, culture, and training*' and its implications on mathematics teachers at secondary schools. The policy document highlights the main features of Learner-Centred approaches. Therefore, the aim of the study is to investigate how mathematics teachers implement Learner-Centred Education in Mathematics classrooms in Namibia. The following research questions are addressed:

1. What is the nature of classroom teaching practices for a Learner-Centred Mathematics curriculum in Namibia?
2. To what extent are Learner-Centred practices present in Mathematics classrooms in Namibia?

This study presents a qualitative research that involved eight weeks of fieldwork investigations of Secondary school Mathematics teachers' classroom practices. Specifically, this study utilized multiple case studies (Glesne, 1999; Merriam, 1998) where three mathematics classrooms were selected from three different schools. Classroom observations were carried out in order to understand the nature of teachers' classroom practices. A video camera was used to capture maximum classroom activities and participation of both the teacher and the learners. Semi-

structured interviews were conducted using an audiotape recorder and field notes. The descriptive data (video tape lessons and interviews) were analysed verbatim. The results revealed different types of classroom interactions that were common in the three classrooms. These include among others, question and answer dialogue between the teacher and the learners. In this case, negative utterances or affirmative answers in the form of 'yes' or 'no' answers were given; teachers giving instructions; learners asking for clarification or the teachers asking learners to give explanations and the teacher giving feedback.

Using the results findings, it is concluded that Mathematics teachers at Senior Secondary schools used the expository method more often in their teaching than other teaching methods such as lecturing and discussions. The teachers also used the chalkboard very often, especially when assigning class activities. The textbooks were mostly used as referrals. However, the teachers endeavoured to implement Learner-Centred approaches in their teaching because their lessons indicated a shift towards Learner-Centredness.

March 2008

DECLARATION

I declare that *Translating policy into practice: Aspects of learner-centred classroom practices in mathematics in Namibia secondary schools* is my own work, that it has not been submitted before for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged as complete references.

Name: Hileni Magano Kapenda March 2008

Signed: ……..

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DEDICATION

This thesis is dedicated to my uncle, Professor Filemon Amaambo, who persuaded and convinced me to further my career in education.

LIST OF ACRONYMS

BETD	Basic Education Teacher Diploma
ETSIP	Education and Training Sector Improvement Programme
EU	European Union
HIGCSE	Higher International General Certificate of Secondary Education
IGCSE	International General Certificate of Secondary Education
INSTANT	In-Service Training and Assistance for Namibian Teachers
ITTP	Integrated Teacher Training Programme
LCE	Learner-Centred Education
MBEC	Ministry of Basic Education and Culture
MBESC	Ministry of Basic Education Sport and Culture
MEC	Ministry of Education and Culture
NAMCOL	Namibian College of Open Learning
NEC	Namibian Education Centre
NHRDP	Namibia Human Resource Development Programme
NIED	National Institute for Educational Development
NSSC	Namibia Senior Secondary Certificate
SIDA	Swedish International Development Authority
SWAPO	South-West Africa People's Organisation
TERP	Teacher Education Reform Project
UNAM	University of Namibia

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Chapter 1

OBJECTIVES AND SIGNIFICANCE OF THE STUDY

1.1 INTRODUCTION

Before Namibia gained independence from the South African regime on 21 March 1990, the colonial and so-called "bantu' education system that had prevailed until then did not emphasize Mathematics and Science subjects. According to Tjikuua (2000, p.1), "...Mathematics and Science Education was predominantly for the whites, which constitute a very small percentage of the population." Apart from skills in basic literacy in the mother-tongue and a utilitarian knowledge of Afrikaans and English, the syllabus for black pupils put emphasis on manual training, tribal heritage, agriculture, religious instruction, elementary arithmetic and hygiene (Cohen, 1994, p.97). To date, Mathematics education in Namibia has not fully recovered from some colonial malpractices. A Task Force on 'Improving Mathematics in Namibia' (23-27 September 2002) reports that irrespective of "projects, papers written, and research carried out in Mathematics and Mathematics education…there has not been a great deal of improvement resulting from these efforts; learners still under-achieved in Mathematics" (Namibia Human Resource Development Programme [NHRDP] (2002, p.3).

The educational reform (1986 – 1995) in Namibia proposed pedagogical changes in the classrooms, namely the introduction of Learner-Centred approaches. To advocate and promote this new reform, several projects such as the Integrated Teacher Training

Programme (ITTP) project, the In-Service Training and Assistance for Namibian Teachers (INSTANT) project and the Basic Education Teacher Diploma (BETD) were introduced. These projects aimed at the improvement and for quality education in Namibian schools as outlined below.

1.1.1 The Integrated Teacher Training Programme (ITTP)

The ITTP can be considered as the first initiative by the South-West Africa People's Organisation (SWAPO) in the late 80's to change the education system for the Namibians in exile. According to Cohen (1994, p.242), this three-year training programme for primary school teachers dated from 1986. Half of the programme was conducted at Kwanza Sul in Angola and the rest at the University of Umeå in Sweden. The ITTP was created as a basis for transition during the 10 years in which Namibian and Swedish educators worked together at the Namibian Education Centre (NEC) at Kwanza-Sul in developing an educational praxis based on a critical pedagogy (Dahlström, 2000). Dahlström (2000, p.19) further states that, "The first curriculum for the innovative Integrated Teacher Training Programme was developed jointly by a group of Namibian and Swedish educators in 1986." The training was unconventional because of the relative stress on linking theory and practice (Cohen, 1994, p.242). The programme also further developed its integrated approach in co-operation with Namibian educators in Angola and Sweden as well as in Namibia during the first few years after independence. This move later laid the foundation for the establishment of the Basic Education Teacher Diploma (BETD) that is still running today.

1.1.2 The Basic Education Teacher Diploma (BETD)

In 1992, a teacher preparation programme was initiated with the support of the Teacher Education Reform Project (TERP), which was financed by the Swedish International Development Authority (SIDA) (Mutwa, 2002). As a result, the Basic Education Teacher Diploma (BETD) was introduced and established in 1993 as a pre-service teacher-training programme. The BETD, like the ITTP, is also a three-year training programme for Primary and Junior school teachers. According to Swarts (2000, p.7), "The BETD is a unified, general preparation for all teachers in basic Education." The programme is based on the philosophical concept of Learner-Centredness that demands a high degree of learner's participation, contribution and production. Swarts (2000) further emphasises on this aspect by stating that the BETD tries to put a balance between theory and practice; professional aspects and content knowledge and between college-based and school-based experiences. To date, the four colleges of education, namely Caprivi College, Ongwediva College, Rundu College and Windhoek College, serve as pre-service teacher-training institutions for the BETD programme in Namibia.

1.1.3 The In-Service Training and Assistance for Namibian Teachers (INSTANT) Project

The INSTANT project was launched immediately after independence in January 1991 and operated until the end of 1997 with the aim to guide the educational reforms in Science and Mathematics education (Ottevanger, Macfarlane and Clegg, 2005). The European Union (EU), in conjunction with the Ministry of Basic Education and Culture, funded the project. According to Ottevanger *et al*. (2005, p.37), "The project was set up to guide the process of educational reform and curriculum change primarily to achieve a

change in teaching methodology..." The INSTANT was introduced as an emergency training for Junior Secondary teachers needed to teach Science and Mathematics from Grade 8 to 10. This move was necessary and essential because there was a shortage of Mathematics as well as Science teachers in most regions in the country, especially since the two subjects were made compulsory to all learners up to Grade 10.

Ottevanger *et al*. (2005, p.38) also report that "Notably, the project put emphasis on the interacting areas of curriculum development and teacher development." In curriculum, the project focused on the intended curriculum by involving the staff in the curricula both for upper Primary and Secondary education. For teacher development, the project mainly targeted teachers in the schools directly through workshops (Ottevanger *et al.,* 2005, p.39). Teacher support materials as well as learners' materials were produced. Close to the end of the programme (1994 – 1995), some of these teachers were trained to teach the International General Certificate of Secondary Education (IGCSE) content using methods that support Learner-Centred Education in Namibia.

1.2 STATEMENT OF THE PROBLEM

Although the government of the Republic of Namibia has advocated the Learner-Centred Education as opposed to teacher-centred education, through written policy documents, workshops and training sessions (Ministry of Education & Culture, MEC, 1993), most teachers in Namibia are still experiencing problems with the implementation of this 'new' philosophy. Kamupingene (1998, p.124) confirms this statement by reporting that "There is a lack of common understanding of Learner-

Centred Education in Namibia." The MBEC (1999, p.15) mentions that "even though Learner-Centred Education is a good idea, many teachers have difficulties with it. The challenge faced by Namibian teachers is to overcome these difficulties." This study therefore aims at investigating how Mathematics teachers in Namibia implement Learner-Centred Education (LCE) in Mathematics classrooms at secondary levels.

1.3 MOTIVATION OF THE STUDY

Since I joined the teaching profession in the late 80's, I have had an interest in trying to understand the dynamics of classroom situations. For me, the dynamics of classroom environment not only exist due to multi-sociocultural aspects of the school community, but it is also created by the environment that surrounds the school as well as other forces outside the school, namely the higher authority governing the schools. Therefore, all the factors mentioned above give a holistic approach to this study.

Several studies concerning Learner-Centred Education in Namibia were carried out around 1997 – 2002. Examples include: *Learner-centred education in Namibia: A case study* (Chaka, 1997); *Beginning teachers' perceptions of a learner-centred approach to teaching in Namibia* (Sibuku, 1997); *Learner-centred education: Development of teachers' concepts and practice of teaching in the context of Namibia school reform* (Shinyemba, 1999); *Learner-centred education: equal group work? Findings from Namibian classrooms* (van Graan, 1999); *In-Service education and classroom practice: Geography teaching in Namibia* (Mutwa, 2002) and *Learner-centredness and group work in Second Language teaching: A shattered dream* (Shaalukeni, 2002). However,

most of these studies were carried out at Primary and Junior secondary schools. That is, they fall short of examining the aspects of Learner-Centred Education at Senior Secondary level, which is the main emphasis of this study. Since the inception of Learner-Centred Education, most emphasis has been placed on basic education through various programmes and initiatives, as mentioned earlier. Therefore, this study concentrated on Secondary schools and more specifically, on Mathematics which is still "one of the crucial subjects necessary for any country…" (NHRDP, 2002, p.3).

The intended outcome of Learner-Centred Education is the production of 'action knowledge' (becoming part of the learner's worldview) rather than 'school knowledge' (remaining separate from learners' actions) (Barnes, 1976). As Mathematics is perceived by many as an abstract subject area, the focus on the implementation of LCE in Mathematics teaching is particularly crucial.

1.4 AIMS AND RESEARCH QUESTIONS

The aim of this study is to investigate how Mathematics teachers in Namibian secondary schools implement Learner-Centred Education. The following research questions are addressed:

1. What is the *nature* of classroom teaching practices for a Learner-Centred Mathematics curriculum in Namibia?
2. To what *extent* are Learner-Centred practices present in Mathematics classrooms in Namibia?

1.5 THEORETICAL FRAMEWORK

The theoretical framework of this study draws on the following directions of educational research, namely: educational change, Mathematics education and social constructivism (Learner-Centred Education). This study specifically falls within the paradigm of *Methods of Teaching* because it endeavours to address Mathematics teachers' classroom practices. A conceptual framework given below in Figure 1.1 attempts to explain the relationship between some of the main concepts used in this study in order to describe the underpinning principles that guide this study. These concepts also guided the analysis of data as well as the discussion of the results in this research.

Using recent work of Rogan and Grayson (2003) as well as Rogan and Aldous (2005), the conceptual framework given below was adapted because (1) although Rogan and Aldous' study also looked at curriculum implementation in one of the developing countries (RSA) the emphasis was on science education, (2) this study is based on Mathematics education and it puts emphasis on classroom practices (interaction), and (3) their framework share three important characteristics that enable me to do the adaptation, namely:

- The constructs can be measured by means of indicators;
- They are broad enough to encompass a number of related factors and
- They are narrow enough to include one main idea (Rogan and Grayson, 2003, p.1180).

Therefore, it was imperative to adapt the conceptual framework in order to make it relevant to this study.

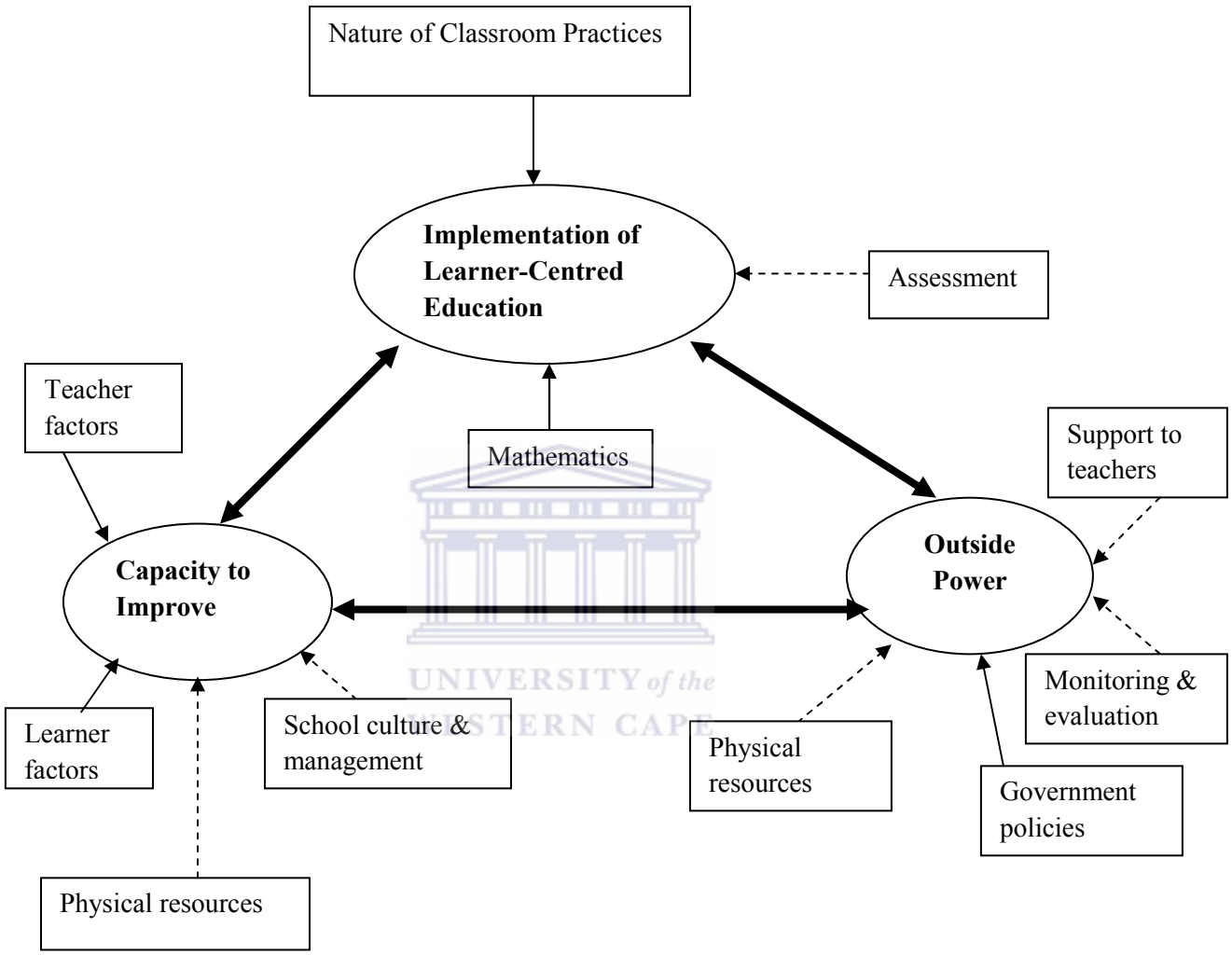


Figure1.1 A conceptual framework for this study [Adapted from Rogan and Aldous, 2005, p.314]

There are three main constructs in this conceptual framework, namely Implementation of Learner-Centred Education, Capacity to Improve and Outside Power. These constructs are theoretical and need not necessarily be related, but they are general constructs

emanating from the literature to discuss issues related to implementation of curriculum reform initiatives. A sub-construct 'Nature of Classroom Practices' links directly to the main construct 'Implementation of Learner-Centred Education' because the study investigated the nature of classroom teaching practices for a Learner-Centred Mathematics curriculum. A sub-construct 'Mathematics' is placed in the centre of the three main constructs to indicate the context of the study. 'Outside Power' refers to the outside authorities such as the Ministry of Education and other organizations that support school initiatives such as physical resources (e.g., textbooks, buildings, curriculum materials, etc.), government policies, support to teachers and monitoring and evaluation. It is assumed that the indicators mentioned above may directly or indirectly support or hinder the implementation of Learner-Centred Education. The 'Outside Power' may also influence the "Capacity to Improve' the 'Implementation of LCE'. Therefore, successful implementation of LCE is more likely to occur if there is alignment between the three main constructs according to the different sub-constructs or indicators. That means, the implementation must take the context of a particular school (its teachers, learners, leadership and environment) into consideration (Rogan and Grayson, 2003, p.1175). It is of importance to note that the sub-constructs Assessment (learners' tasks, teaching etc.), Monitoring and evaluation (from inspectors or directors of education), Teacher support (academic, moral or financial support), Physical resources and School culture and management are indicated with broken arrows because, although they are important components of teaching and learning situation, this study did not explicitly address these components.

1.6 DEFINITION OF TERMS

Learner-Centred Education: Is defined to mean the following:

- the starting point at each stage of a learning process is each learners' existing knowledge, skills, interests and understanding, derived from previous experience in and out of school;
- the natural curiosity and eagerness of all young people to learn to investigate and make sense of a widening world must be catered for by a variety of challenging and meaningful tasks;
- the learners' perspective must be appreciated and taken into consideration in the work of the school;
- learners should be empowered to think and take responsibility not only for their own, but for each others' learning and development; and
- learners should be involved as partners in, rather than receivers of, education (MBESC, 1996, p.25).

Constructivist teaching: For this particular study, this refers to the social constructivist ways of teaching in Mathematics classrooms.

"Constructivism provides us with insights concerning how children learn Mathematics"

(Van de Walle, 1998, p.22). Therefore, "constructivist approach to teaching calls on teachers to be learners themselves, revealing how embedded within constructivist teaching experiences are continual opportunities for teachers to learn about students, about students learning, and about the very nature of the learning process itself " (Falk, 1996, p.22).

Classroom practices: For this particular study, this term is used interchangeably with 'classroom interactions'. It refers to interaction practices and classroom communication (verbal and non-verbal) between the teacher and the learners and between the learners and learners themselves.

Secondary Mathematics: This refers to Mathematics content at high school or senior secondary level (mostly) at International General Certificate of Secondary Education (IGCSE) level.

Mathematics instruction: This refers to teaching or instruction that offers Mathematics as a school subject, especially at senior secondary or high school level. Specifically in this context, the Mathematics teaching that involves a dimension of 'substantial' and 'construction' of mathematical concepts in relation to 'formal' and 'descriptive' concepts (Pellerey, 1985, p.3248-3249).

Mathematics curriculum: This refers to a school curriculum that addresses Mathematics as a school subject.

Mathematics teacher experience: This refers to the experiences gained through teaching Mathematics as a school subject.

1.7 STRUCTURE OF THE STUDY

In this study, **Chapter one** gives a brief introduction on the historical background and the aims of the three teacher-training projects that were launched as part of the educational reform in Namibia. The statement of the problem, as well as the research questions, is also stated in this chapter. A conceptual framework for this study is illustrated in Figure 1.1. The chapter ends by giving definitions of terms used in this study as applied within the context. **Chapter two** gives an overview of the main concepts used in this study in relation to the research questions. Review of relevant literature provides better understanding of the concepts used. These concepts are: Learner-Centred Education, Curriculum implementation, and Mathematics teaching. This chapter also highlights the theoretical framework of this study. In **Chapter three**, I give a detailed account of the research designs used, sampling procedures, research instruments, procedures used to collect data and the methods of analysis. The results from a pilot study that was conducted for piloting the research instruments are also given for the verification of validity and reliability of the instruments. The presentation of the results is given in **Chapter four** while the discussions of the data appeared in **Chapter five**. **Chapter six** includes the summary, conclusions and recommendations of this study.

Chapter 2

LITERATURE REVIEW

2.1 INTRODUCTION

The previous chapter dealt with an overview of the educational reform in Namibia prior to independence. The need to change classroom practices was highlighted in the section that motivates the need for this study. This chapter discusses the educational concepts, theories and the approaches to Learner-Centred Education, namely curriculum concepts, social constructivist theory and approaches to Mathematics teaching. The reader is provided with a theoretical background on educational policies, curriculum issues and Learner-Centred approaches in Mathematics teaching. An overview of the concept Learner-Centred Education is given first. Second, curriculum terms such as curriculum policies and curriculum implementation are discussed. The two concepts, curriculum policy and curriculum implementation are then drawn together to explain the notion of Learner-Centred Education in a social constructivist theory of learning. The approaches to Mathematics teaching and learning are examined in relation to the concept Learner-Centred Education, which is the main concept of this study.

2.2 LEARNER-CENTRED EDUCATION (LCE)

2.2.1 Historical background of LCE

The term Learner-Centred Education has long been in existence in the education setting (Kapenda, 2007). Its origin could be traced back to the work of some of the well-known

philosophers and educators such as Confucius, Socrates, Jean-Jacques Rousseau, Colonel Francis Parker, Pestalozzi, just to mention but a few (Cuban, 1993 and Henson, 2003). According to Henson (2003), the history of LCE stands on two feet. It has one foot in the philosophy and the other in the psychology as discussed below.

Henson (2003) speculates that the Chinese philosopher Confucius and the Greek philosopher Socrates (around the 5th and 4th centuries B. C.) were the earliest individual teachers to have intense and direct effect on Learner-Centred Education. Later on, around the 16th century, Johann Pestalozzi was influenced by Rousseau's writings and decided to open a school in Switzerland, with a Learner-Centred curriculum (Henson, 2003). Henson further writes that during that time Fredrick Froebel (in Germany) used the Learner-Centred, Child-Centred, and experience-based ideas to develop the world's first kindergartern. Centuries later, with the influence of diverse notions from various educators (such as John Locke's tabula rasa, Francis Bacon's scientific method, Immanuel Kant's pragmatism and others) John Dewey at the famous School of Education, University of Chicago, idealised the concept Learner-Centred Education to "embrace the idea that education should be both problem-based and fun" (Henson, 2003, p.3). Dewey further recognised that each child has both a psychological as well as a social dimension. Therefore, in opposition to Rousseau's idea of protecting children from the society, Dewey strongly believes that "the only way a child would develop to its potential was in a social setting" (Henson, 2003, p.3). The social aspect of a child (learner) will be discussed further in the next subsection, specifically under social

constructivism because Learner-Centred Education has many aspects that feature social constructivist theory (see Section 2.3).

During the 20th century, several psychological developments such as perceptual psychology, constructivism, and disposition (among others) influenced the development of Learner-Centred Education (Henson, 2003, p.4). By the mid-twentieth century, psychologists concluded that perception has a great effect on behaviour and on the moulding of what type of people learners will become. Arthur Combs in the book entitled *Perceiving, Behaving, Becoming*, which he edited in 1992, states:

> If students perceive themselves as good students and worthy individuals, they will work hard to protect these images; however, if they perceive themselves as poor students and people of little value, they will behave accordingly (Combs, 1992, *cited in* Henson, 2003, p.5).

According to Henson (2003, p.5), perceptual psychologists believe that through a sense of efficacy Learner-Centred teachers can nurture the development of positive self-concepts by (1) assigning problems that challenge students but are within their abilities (2) encouraging them to succeed and (3) recognizing students' success. According to Henson (2003, p.6), the review of literature that supports Learner-Centred Education suggests several important dispositions. Most of them include the following characteristics:

- Education should be experience-based;
- Each individual learner's own unique qualities and dispositions should be considered when planning a curriculum;
- The learners' perceptions should shape the curriculum;
- Learners' curiosity should be fed and nurtured;

- Learning is best when it involves emotions and
- The learning environment should be free from fear.

In general, the term Learner-Centred Education embraces terms such as, active learning, exploration, self-responsibility, learners' prior knowledge and skills as well as the construction of knowledge rather than passive participation of students (American Psychological Association (APA), 1997; Edmund and Stephens, 2000; Fardouly, 1998; McCombs and Whisler, 1997; Norman and Spohrer, 1996; Rowell, 1995; Thompson, Licklider and Jungst, 2003; Walczyk and Ramsey, 2003 and Woelfel, 2004).

From a research-based perspective, McCombs and Whisler (1997) distinguish the concept Learner-Centred from child or student-centred by defining it as:

> A perspective that couples a focus on individual learners (their heredity, experiences, perspectives, backgrounds, talents, interests, capacities, and needs) with a focus on learning (the best available knowledge about learning and how it occurs and about teaching practices that are most effective in promoting the highest levels of motivation, learning, and achievement for all learners) (p.9).

Van Harmelen (1998) differentiates between Learner-Centred and Child-Centred education by stating that:

> In presenting the case for learner centred education as theoretically different from child centred education, I argue that child centred education is essentially linked to a particular perception of *childhood*, whereas learner centred education is concerned with *how learning occurs* and knowledge is acquired by all learners (p.3).

According to Entwistle (1974), Child-Centred education puts a lot of emphasis on the child as a *free* individual. He states: "The initial concentration of attention upon the child was a moral protest against the abuse of childhood; an outcry against treating the child as

a means to an end..." (p.17). According to Brandes and Ginnis (2001), the other term 'Student-Centred Learning' was invented by Carl Rogers. They describe the term 'Student-Centred Learning' as "A system of providing learning which has the student at his heart" (p.1). The term 'Child-Centred education' is too radical in comparison to Learner-Centred Education. However, the term 'student-centred learning' has a closer meaning to the concept Learner-Centred Education. Both Learner-Centred and Student-Centred put a learner/student at the centre of learning. Therefore, the two terms Student-Centred and Learner-Centred can be used interchangeably in this study.

In its document entitled *How learner centred are you*?, the Ministry of Basic Education and Culture (MBEC) in Namibia, specifically defines the term Learner-Centred Education as:

> An approach to teaching and learning that comes directly from the National Goals of equity (fairness) and democracy (participation). It is an approach that means that teachers put the needs of the learner at the centre of what they do in the classroom, rather than the learner being made to fit whatever needs the teacher has decided upon… learning must begin by using or finding out the learners' existing knowledge, skills and understanding of the topic…Then teachers develop more activities that build on and extend the learners' knowledge (MBEC, 1999, p.2).

The translation of the rhetoric into practical reality concerning Learner-Centred approach is ambiguous, because according to the Ministry of Basic Education and Culture (1999, p.3) it is further stated that "No lesson is ever completely Learner-Centred or Teacher-Centred …in one lesson, and a teacher might use different approaches for different dimensions." Therefore, teachers need to use their own discretion (for example, taking into account different dimensions such as classroom set-up, teacher talk, content and lesson activities) in order to apply a Learner-Centred approach in their teaching. This situation could, therefore, be one of the causes that hinder proper implementation of

Learner-Centred approaches in Namibian classrooms, because teachers tend not to know where to draw the boundaries between teacher-talk and Learner-Centred approaches.

2.2.2 Learner-Centred psychological principles

The following principles played a role in the development of LCE. McCombs and Whisler (1997, p.5) identify what they call 'Twelve Learner-Centred Psychological Principles' which reflect their perspective on learner-centredness as:

- *The nature of the learning process*. Learning is a natural process of pursuing personally meaningful goals, and it is active, volitional, and internally mediated; it is a process of discovering and constructing meaning from information and experience, filtered through the learner's unique perceptions, thoughts, and feelings.
- *Goals of the learning process*. The learner seeks to create meaningful, coherent representations of knowledge regardless of the quantity and quality of data available.
- *The construction of knowledge*. The learner links new information with existing and future-oriented knowledge in uniquely meaningful ways.
- *Higher-order thinking*. Higher-order strategies for 'thinking about thinking" – for overseeing and monitoring mental operations – facilitate creative and critical thinking and the development of expertise.
- *Motivational influences on learning*. The depth and breath of information processed, and what and how it is learned and remembered, are influenced by (a) self-awareness and beliefs about personal control, competence, and ability; (b) clarity and saliency of personal values, interests, and goals; (c) personal expectations for success or failure; (d) affect, emotions, and general states of mind; and (e) the resulting motivation to learn.
- *Intrinsic motivation to learn.* Individuals are naturally curious and enjoy learning, but intense negative cognitions and emotions (e.g. feeling

insecure, worrying about failure, being self-conscious or shy, and fearing corporal punishment, ridicule, or stigmatising labels) thwart this enthusiasm.

- *Characteristics of motivation-enhancing learning tasks*. Curiosity, creativity, and higher-order thinking are stimulated by relevant, authentic learning tasks of optimal difficulty and novelty for each student.
- *Developmental* constraints and opportunities. Individuals progress through stages of physical, intellectual, emotional, and social development that are a function of unique genetic and environmental factors.
- *Social and cultural diversity*. Learning is facilitated by social interactions and communication with others in flexible, diverse (in age, culture, family background, etc.), and adaptive instructional settings.
- *Social acceptance*, *self-esteem, and learning*. Learning and self-esteem are heightened when individuals are in respectful and caring relationships with others who see their potential, genuinely appreciate their unique talents, and accept them as individuals.
- *Individual differences in learning*. Although basic principles of learning, motivation, and effective instruction apply to all learners (regardless of ethnicity, race, gender, physical ability, religion, or socio-economic status), learners have different capabilities and preferences for learning mode and strategies. These differences are a function of environment (what is learned and communicated in different cultures or other social groups) and heredity (what occurs naturally as a function of genes).
- *Cognitive filters*. Personal beliefs, thoughts, and understandings resulting from prior learning and interpretations become the individual's basis for constructing reality and interpreting life experiences.

These principles are explained in detail in a document entitled *Learner-centred Psychological Principles: Guidelines for School Redesign and Reform* by McCombs and

others. The document was a product of a special Presidential Task Force that was appointed by the American Psychological Association (APA) in 1990 and asked to (1) determine ways in which the psychological knowledge base relates to learning, motivation, and individual differences and how it could contribute directly to improvements in the quality of student achievement and (2) provide guidance for the design of educational systems that would best support individual student learning and achievement (McCombs and Whisler, 1997, p.3). They further explain that the twelve principles cannot be considered in isolation if maximum learning is to occur for each student. The five domains that embrace the twelve Learner-Centred principles are: metacognitive and cognitive, affective, developmental, personal and social as well as individual differences. The relationship between the learner, learning, and the five domains is given by the illustration of a "Learner-Centred Model" given below in Figure 2.1.(on the next page).

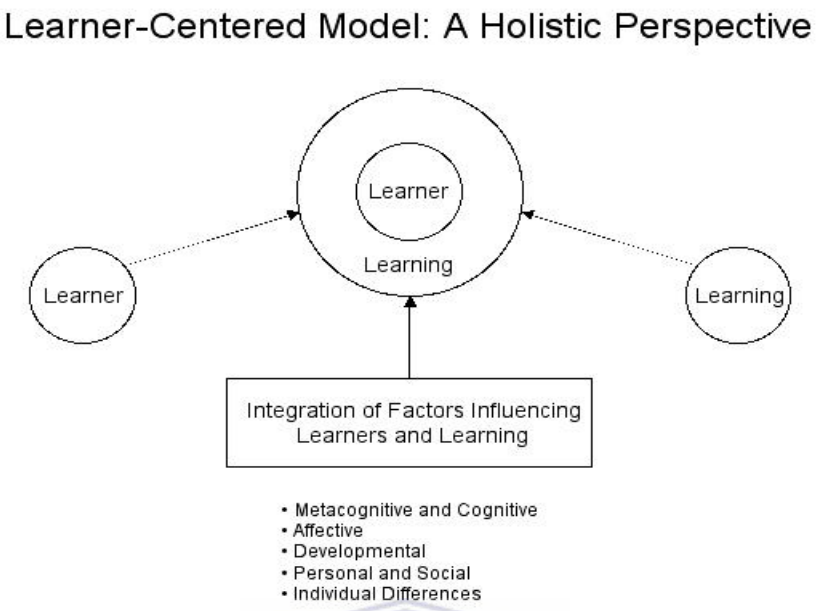


Figure 2.1 Learner-Centred Model: A Holistic Perspective [from McCombs and Whisler (1997, p.12)].

According to McCombs and Whisler (1997), the model above provides a holistic perspective of the concept Learner-Centred Education. However, this model concentrates on the learner alone without incorporating the teacher. The model gives an impression that the learner can learn on his or her own without guidance from the teacher. The teacher as a facilitator of learning should play a role in Learner-Centred Education. Dewey (1997) categorically emphasised how a teacher plays an important role in teaching. Hence, Dewey's theory on education diverted from Child-Centred education and relates more to constructivist theory of learning.

2.3 THEORY OF CONSTRUCTIVISM

The Swiss psychologist and educator, Jean Piaget, has been credited as a pioneer of constructivist thought (Dougiamas, 1998; Ernest, 1994 and Henson, 2003). According to Hersant and Perrin-Glorian (2005, p.113) constructivist theory "suggests that students give meaning to knowledge and can use it by themselves only when they have developed this knowledge as an answer to some problem..." Some of the main terms associated with the concept constructivism are: learner's prior knowledge, cooperative learning, and meaningful learning, just to mention but a few. Funderstanding (2007, p.1) defines the term constructivism as:

> A philosophy of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world we live in. Each of us generates our own "rules" and "mental models," which we use to make sense of our experiences. Learning, therefore, is simply the process of adjusting our mental models to accommodate new experiences (see website: http://www.funderstanding.com/contructivism.cfm).

In his paper *A Journey into Constructivism*, Dougiamas (1998) provides his own definition of constructivism as follows:

> Constructivism is building on knowledge known by the student. Education is student-centered, students have to construct knowledge themselves. Explanations can use metacognition to explain via metaphor. Semiotics, or meanings of words, are important to keep in mind. Constructivism is a theory, a tool, a lens for examining educational practices (p. 3).

Murphy (1997, p.4) talks about "multiplicity as an overriding concept for constructivism." This means that various types of constructivism exist (Dougiamas, 1998; Ernest, 1994) (see also website: http://www. constructivism123.com). While Ernest (1991) provides positive criticism (especially on social constructivism), Dougiamas (1998) identifies what he calls the six "faces" of constructivism as:

- Trivial constructivism
- Radical constructivism
- Social constructivism
- Cultural constructivism
- Critical constructivism and
- Constructionism

From the six faces highlighted by Dougiamas, this study focused on social constructivism, because this branch of constructivism has been found to link well with either the teaching and learning of Mathematics or the issues of Learner-Centred Education (Ernest, 1991; Henson, 2003, respectively). Ernest (1991, p.42) comments, "social constructivism views Mathematics as a social construction." Henson (2003, p.5), on the other hand, describes constructivism as a "Learner-Centred educational theory that contends that to learn anything, each learner must construct his/her own understanding by tying new information to prior experiences."

Learner-Centred Education is, therefore, said to rely more on the theory of social constructivism, because social constructivism takes into account the social nature of the learning environment as a collaborative atmosphere between teachers and learners (Dougiamas, 1998; Hanley, 1994; Murphy, 1997 and Roesler, 2002). Roesler (2002) mentions that in a social constructivist classroom, learners play an active role because they are able to construct their own meanings, rather than just memorising and reciting the 'correct' answers. Roesler (2002, p.15) further highlights some of the elements that would represent a typical constructivist Mathematics classroom as follows:

- Exploration of real-world phenomena, possibilities and problems;

- Recognition for the role of patterning in understanding mathematical functions and application of Mathematics structures;
- Appreciation of the objectivity and utility of mathematics, as well as its fallibility and culture-boundedness;
- Emphasis on exploration;
- Abundant use of manipulatives;
- Simultaneous and varied activities;
- Emphasis on small group work;
- Little concern about time and
- Flexibly arranged furniture.

This study used some of Roesler's (2002) features as guidelines for a checklist to monitor indicators on Learner-Centred activities in a Mathematics classroom. For example, during classroom observations, features such as exploration of real-world problems, abundant use of manipulatives, varied activities, emphasis on small group work, little concern about time and flexibly arranged furniture could be identified and recognised. On the other hand, features such as, appreciation of the objectivity and utility of mathematics and recognition of patterning in understanding mathematical functions were difficult to monitor during classroom observations.

2.4 CURRICULUM CONCEPTS

2.4.1 What is curriculum?

The term 'curriculum' is used broadly by teachers and educators, hence different meanings are attached to it. According to Ornstein and Hunkins (2004, p.10), "curriculum can be defined as a *plan* for action or a written document that includes strategies for achieving desired goals or ends." Ornstein and Hunkins also explain that this type of

definition exemplifies a linear view of curriculum as opposed to the broad definition of curriculum that deals with the experiences of the learners. They further provide three distinct definitions of curriculum, namely: 1) Curriculum can be considered as a 'system' for dealing with people and the processes or the organization of personnel and procedures for implementing that system. 2) Curriculum can also be viewed as a field of study, comprising its own foundations and domains of knowledge, as well as its own research, theory and principles and its own specialists to interpret this knowledge. 3) Curriculum can be considered in terms of subject matter (Mathematics, Science, English, History etc.) or content (the way we organize and assimilate information (p.11). However, Ornstein and Hunkins (2004) caution that the last definition has no advocate because in most cases school systems have a tendency to develop curriculum in terms of different subjects and grades.

Graham-Jolly (2002, p.21) explains that "the term curriculum is often used to refer to the formal academic programme provided by a school, as reflected in subjects on the timetable…or to describe a course of study…" Creemers (1994, p.37) states that the term curriculum has been used over the years to indicate a variety of documents, especially in the European tradition. Creemers further mentions that, originally a curriculum was a term used to refer to a document at school, containing information about the time schedule, aims, objectives and methods. Later, the term curriculum was used for textbooks. Nowadays, other terms are introduced to distinguish documents at the different school levels (Creemers, 1994, p.37).

Kelly (1989; 2004) points out that the term 'curriculum' is used with several meanings and has many dimensions because of the different definitions that are attached to it. He therefore, distinguishes the use of the word either to denote the content of a particular subject (or area of study) or to refer to the total programme of an educational institution. Kelly (1989) further argues that, since most people still use the word 'curriculum' and 'syllabus' interchangeably, this perception limits their planning in terms of the content or the body of knowledge they wish to transmit. Kelly (1989), therefore, cautions the reader to be aware of the limiting factors provided by the type of definition the term 'curriculum' is given because "it is likely to hamper rather than to assist the planning of curriculum change and development" (p.10).

In summary, the term 'curriculum' as defined above by various authors (Kelly, 1989 and 2004; Creemers, 1994; Ornstein and Hunkins, 2004 and Graham-Jolly, 2002) has various meanings. In the education context, the term could be used to mean a plan for action, a written document, a system and a process of dealing with people, a field of study, a content for a specific grade or programme or a subject matter. Therefore, as Kelly (1989) points out, one should be aware of the limiting factors provided by each definition, especially when it comes to the planning of curriculum change and development. Definition of the term 'curriculum' should, therefore, be viewed in terms of the context used, specifically in this study the term curriculum refers to a system and a process of dealing with people, a content for a specific grade or subject matter, a written document or a plan for action (implementation).

2.4.2 Different types of curriculum

The intended or planned curriculum

The intended or planned curriculum refers to what is *intended* by the curriculum developers and policy makers to be taught in the schools (usually) through the syllabi, prospectuses or other relevant approved educational documents (Kelly, 2004). According to Barwell (2000, p.36), the intended curriculum as often presented in the form of a syllabus or other written document, highlights what teachers are expected to teach.

In Namibian Senior Secondary schools, the newly implemented Namibia Senior Secondary Certificate (NSSC) syllabus as well the Scheme of Work documents, form parts of the intended curriculum. Most senior secondary government schools in Namibia are provided with lists of prescribed as well as recommended textbooks. The schools will then order (from publishers) different textbooks according to their preferences. Hence, the syllabus remains the most important document for curriculum implementation as well as a good reference for assessment criteria because at senior secondary level, the examinations are set according to the syllabus. From the researcher's experience as a senior secondary teacher as well as a supervisor for teaching practice at senior secondary schools, the NSSC syllabus is highly valued as an important document. In a few cases, some teachers provide their students with copies of the syllabus in order to make sure that the students identify the required objectives (to be achieved at the end of the course).

The implemented or received curriculum

The implemented or received curriculum refers to what is being taught in the classroom. Different school subjects offered at school level constitute the implemented curriculum. Kelly (2004, p.6) defines the received curriculum as "the reality of the pupils' experience." According to Barwell (2000, p.36), the implemented curriculum is the result of the intended (planned) curriculum being put into practice. This includes both the content as well as the way it is taught, for example, classroom activities, classroom interactions and homework. However, the teacher remains the important element in the implementation process because, as Barwell (2000, p.37) puts it, "the implementation of a (Mathematics) curriculum entails a process of interpretation on the part of the teacher." Kelly (2004) supports Barwell' statement by mentioning that in order to succeed in linking the theory and practice, the gap between the planned and the received curriculum should be closed.

The formal and informal curriculum

According to Kelly (2004), the formal curriculum includes the formal activities at school that are allocated specific periods of teaching on the timetable. The informal activities are often called 'extracurricular activities', namely sports, clubs, excursions and so on. Kelly (2004), however, argues that although these informal activities are seen as separate, the reasons for separating them are difficult to distinguish. He further explains that curriculum planning should, therefore, include both formal and informal activities of a school because they form an integral part of the total educational programme.

The achieved curriculum

The achieved curriculum refers to what has been attained by curriculum implementers (namely teachers) during curriculum implementation, either through formal or informal assessment. Barwell (2000, p.36) defines it as "what students learn, having experienced the implemented curriculum." It is believed that the alignment and the link across the three parts of the curriculum mentioned above depend on many factors that are beyond the scope of this study.

In summary, different types of curriculum exist and not all of them are discussed in this study. Teachers use the planned curriculum as a guide in their teaching. The implementation of a curriculum is left to the discretion of an individual teacher in his or her classroom. The achieved curriculum through formal or informal assessment reveals the end product or outcome of the intended curriculum.

2.5 CURRICULUM REFORM AND POLICIES

Curriculum reform in general is a world-wide phenomenon that has been going on for decades. Voigts (1998, p.5) refers to it as 'an on-going process'. In most Third World countries, curriculum reform took place when the countries became independent from colonial rules (Hawes, 1991), and Namibia is no exception.

Hughes (1991) specifies two types of policies that have bearing on the school curriculum: (i) The policy that describes the procedures to be followed in formulating the curriculum (including who will be involved and the limits of their authority); (ii) The product of the

curriculum policy-making process to be viewed as the curriculum policy per se (p.137). Hughes (1991) further explains that this policy "establishes the character of the curriculum, often specifying what must, should, or may be taught" (p.137). According to Hughes (1991, p.138), "curriculum policy is a blunt instrument". Therefore, as it has been always the case, local schools and teachers will find ways to gain advantage over curricula policies that are not in agreement with their own preferences.

Several authors (Anderson, 1990; Hill, 1997 and Thompson, 1996) define the term 'policy' as a course of action adopted and pursued by a government, party, business, statesman, individual, and so on. Anderson (1990) specifically explains the term policy as a purposeful course of action followed by an actor who can deal with a problem or matter of concern. Therefore, according to Anderson (1990), public policies emerge in response to public demand or outcry. In Namibia, the broad policy concerns of the Ministry of Education are manifested in its five educational goals (Voigts, 1998, p.3). These are: (a) equitable access to education, (b) improvement of internal efficiency, (c) quality, (d) life-long learning and (e) democratic participation. Furthermore, a policy document entitled *Towards Education for All: A Development Brief for Education, Culture and Training* serves as a guideline for teachers and educators in the implementation of the new philosophy of education (in Namibia), namely the Learner-Centred Education.

Successful implementation of any policy depends on the procedures and techniques involved as well as the communication between different organizations and departments

(Anderson, 1990; Hill, 1997). Understanding matters concerning policies is crucial. Therefore, educational policies, as Duggal (1984, p.21) puts it, should be clear in providing guidelines that will help the people involved. Specifically, as Kelly (2004, p.9) points out, "teachers have a 'make or break' role in any curriculum innovation."

In summary, although most developing countries in Africa reformed their school curriculum immediately after their independence, curriculum reform, in general, is a world-wide event. Success or failure of curriculum implementation policy lies in the hands of a teacher.

2.6 CURRICULUM IMPLEMENTATION

2.6.1 Definitions

According to Marsh (1992, p.180), the term 'implementation' refers to the actual use of a curriculum/syllabus, or what it consists of, in practice. Marsh (1992) further explains that the implementation of a curriculum becomes a reality when teachers execute it with real students in a real classroom (p. 180). Although Fullan (1991, p.378) mentioned that "the concept implementation has proven difficult to define," he attempts to define the term 'implementation' as "…putting into practice something which is new to the person who is attempting to bring about a change." Fullan (1991, p.378) outlines the term 'curriculum implementation' as "the process of putting a change into practice."

2.6.2 Factors Affecting Curriculum Implementation

According to Fullan (1991), research has succeeded (since the mid 60s) in identifying a number of factors commonly found to influence change in practice. These are broadly categorized by Fullan (1991, p.379) as:

a) Characteristics pertaining to the curriculum change being attempted

Changes are seen as having different characteristics or attributes when perceived by those attempting to develop them and/or those attempting to use them. These attributes can influence how likely real change is to occur in practice. Rogers and Shoemaker (1971) *cited in* Fullan (1991, p.380) identified a number of attributes. These include among others, compatibility, clarity, complexity, trialability, and observerability. Although the study by Roger and Shoemaker (1971) was based on adoption of outcomes (e.g. farmers adopting a new technology) rather than on individuals in organizational contexts such as school systems, it is believed that since this team's completion of their work, there has been some concentration on the relationship between attributes of curriculum changes and subsequent implementation. Further research studies (Candrall *et al.*, 1982; Emrick and Peterson, 1978; Louis and Rosenblum, 1981 *cited in* Fullan 1991, p.380) also identified four main factors as: need and compatibility, clarity, complexity, quality and practicality of materials. All these attributes characterize changes in one way or another.

b) Local contextual conditions at the school district and school level

Fullan (1991; 2001) differentiates between local conditions and local strategies relative to specific changes. According to his explanations, the local conditions describe the climate

and individual characteristics - at the district level, at the school level, and at the community level - which affect whether curriculum changes will be considered and under what conditions they are likely to be implemented. Several factors such as district leadership, school board and community support, the role of principals, school climate (e.g., professional collegiality among teachers), individual and collective emphasis on and sense of efficacy about instructional matters, and unanticipated critical events are found to influence change in practice.

c) Local Strategies

Fullan (1991) refers to local strategies as the "planning and policy actions taken in relation to implementing specific curriculum changes" (p.381). In-service or development activities and communication-information systems should form part of local strategies for fostering implementation. According to Fullan's explanations, research studies indicate that little change in practice occurs when staff development activities are absent, or when they consist of one-time orientation sessions. By contrast, when staff development activities are conducted prior to and during implementation, significant change in practice is likely to occur.

d) External (to local) factors affecting the likelihood of implementation

These are seen as factors that facilitate or inhibit curriculum implementation. The three factors (Fullan, 1991, p.381) that illustrate this aspect are policy change, financial or material resources, and technical assistance. For example, the introduction of new government policy decisions in the curriculum result in a certain amount of formal

pressure for changes to be implemented, but the mere existence of the policy does not result in much implementation unless several of the factors listed above are also contributors to the changes. However, Fullan (1991) further reports that two recent large scale studies done in the USA found that external training, given by a variety of consultants combined with local consultants or staff, represents a very effective combination in bringing about change in classroom practice (p.382).

Other problems associated with curriculum implementation have been highlighted by Ornstein and Hunkins (1993) to include the following facts:

- Much that is planned and developed often does not get implemented
- Implementing a curriculum often is not considered a crucial stage because more attention is often directed to organizational and management problems than to curriculum change (p.297).

Several authors such as Barwell (2000); Edgerton (1994); Fullan (1991; 2001); Kelly (2004) and Ornstein and Hunkins (1993), have indicated the teacher to be a main feature in curriculum implementation. Marsh (1992), on the contrary, argues that viewing teachers as having absolute powers over what will or will not be implemented in their classrooms is inaccurate because this conjecture is assuming that, a teacher:

- Has the authority to introduce any new course or topics at any time without restrictions from the system, parents, or the community;
- Knows about and has access to the full range of knowledge, skills, and values associated with a particular topic or unit;
- Is in the position of spending the long periods of time needed to prepare student materials (p.181).

Therefore, a realistic view of curriculum implementation lies between teachers and external authorities sharing power equally (Marsh, 1992). Moreover, Fullan (2001) states:

> The more that teachers or others have had negative experiences with previous implementation attempts in the district or elsewhere, the more cynical or apathetic they will be about the next change presented, regardless of the merit of the idea or programme. Districts, provinces or states, and countries can therefore develop an incapacity for change as well as a capacity for it (p.80).

So, whether teachers are able or unable, to implement change depends highly on the support of the community, school boards, parents and the state policies.

2.7 CURRICULUM IMPLEMENTATION IN NAMIBIA

Any government or institution (world wide) responsible for educational matters tries to make sure that implementation of a new curricula is done properly by following the correct steps and procedures and involving all the stakeholders. Implementation processes are usually complex and tedious actions. According to Stoll and Fink (1996, p.65), implementation is a long-range process that requires periodical review and monitoring to see whether activities have taken place as planned and if they appear to be having the intended effect. In most cases, the top-down procedure is followed. That is, the higher authority will make decisions without consulting the people at the grass-root level. This approach has weaknesses in the sense that the people at the grass-root level have little influence on the implementation process and as such must follow what has been decided by the authority. This means that in most cases teachers (grass-root implementers) have to follow prescribed guidelines of what is to be implemented.

Prior to independence, the curriculum in Namibian schools was not relevant to the needs of the country at large and was forced on the people (Age Discrimination in Employment

Act, ADEA, 1999). The ADEA (1999) reports that, although content wise the curriculum was of some use, it did not provide for contextual teaching and learning in a new educational paradigm envisioned for the new nation. Hence, at independence, the new government was compelled to discard the previous regime's curriculum and implement a new curriculum that is more beneficial to the whole Namibian nation. This was done with the involvement of many people at different levels because according to (Skilbeck, 1994, p.1338) curriculum decisions are of direct interest and concern to the community at large. The Ministry of Education and Culture (MEC) (1993) in its *Development Brief for Education, Culture and Training* states:

> A second important basis for the Development Brief has been consultations within the Ministry of Education and Culture and in the education community more generally…… Five Workshops reviewed the draft Development Brief during October. Participants in those Workshops and in individual consultations included personnel from the headquarters and regional offices of the Ministry of Education and Culture and from other ministries and government departments, university faculty and staff, representatives from teachers' unions, student organisations, political parties, private enterprises, and other groups concerned with education, culture, and training. The comments and suggestions, both during the workshops and consultations sessions, were numerous and extensive (p.23-24).

From the quotation above, it can be argued that the new government in the independent Namibia tried to employ down-top procedures in the implementation of the new school curriculum. This gesture is commendable because, as it was stated in the previous paragraphs, the top-down trend which is commonly favoured does not involve the most important implementers of change - teachers.

In alignment with the above-mentioned process of implementing the new curriculum, the National Institute for Educational Development (NIED) in Okahandja was officially established on 20 March 1995. Its purposes are to

develop, establish and confirm curriculum policies & structures and national panels for curriculum reform & development in the whole country. Sustainable user-friendly syllabi for primary and junior secondary schools, as well as support materials (including textbook catalogues) are prepared at NIED annually (ADEA, 1999). The (Higher) International General Certificate for Secondary Education [(H)IGCSE] syllabus for Senior Secondary schools in Namibia (currently under review for localisation) is prepared by the University of Cambridge Local Examinations Syndicate (UCLES) in the United Kingdom (UK). However, NIED still remains the overall governing body of all educational documents and policies.

According to Voigts (1998, p.1), the post-independence reform process in Namibia was initially spearheaded in the formal education sector by the development of new uniform curriculum in the Secondary school phase, followed by a reform of the primary education curriculum. However, curriculum reform (globally) is not static, it is an on-going process, because society is a dynamic entity that requires to be fed with new knowledge, skills and values (Voigts, 1998, p.5) Curriculum, therefore, needs to be revised now and then in order to meet the needs of the society at large. The extent to which the school curriculum is interpreted and implemented depends on how its different sections (parts) are understood and applied.

2.8 TEACHING AND LEARNING APPROACHES IN MATHEMATICS

According to Pellerey (1985, p.3246), "Mathematics instruction has been a main item of any educational curriculum since the most ancient times." From a historical point of

view, the origin of Mathematics could be traced back to ancient Egypt (Burton, 1991; Pellerey, 1985). This means that Mathematics as a discipline or its instruction is very ancient and as such it has gone through a lot of transformation. Pellerey (1985, p.3247) further mentions that the teaching of Mathematics at Secondary schools, around the 19th century was characterized by the rhythm of explanation, study, exercise and interrogation. This situation persisted until the 1960s and 1970s when the New Mathematics movement gained momentum (Pellerey, 1985). However, as Pellerey (1985, p.3248) states: "The support given to the renewal of the teaching of Mathematics (and science), sometimes in an incoherent way, by the psychology of Piaget, lost force, due to new studies and research in the psychology of Mathematics."

A report from a survey prepared by the Schools Council (1977) in London on *Mixed-ability Teaching in Mathematics* states that the aims and objectives of Mathematics teaching have changed over the period of time due to the changing needs of the society (p.19). The Schools Council (1977, p.20) also proposes what they call characteristics of good Mathematics teaching as follows:

- *Quality*: The mathematical content given and variety of tasks should be of great quality in order to ensure that concepts or relationships are formed with strategies in developing mathematical activities. The tasks should be appropriate for the learners in terms of level of difficulty, interest and relevance.
- *Continuity*: In order to ensure continuity teachers should be aware of the structure of the Mathematics course and of the progress of individual learners.
- *Autonomy*: In order to develop learners' autonomy in class, the teacher should try to encourage learners to organize their own materials, assessment or tasks. Learners' independence can also be encouraged by using a variety of teaching

approaches where learner autonomy is enhanced. For example, providing a workshop scheme with a choice of tasks for learners to pursue their own interests.

- *Discussion*: Teacher-pupil as well as pupil-pupil discussions should be used as powerful agents in the classroom in order to promote good teaching and learning.

Several authors (Ashlock, Johnson, Wilson and Jones, 1983; Goulding, 1997; Nickson, 2000 and Selinger, 1994) highlight the importance of social, affective and cognitive domains in the teaching and learning of Mathematics. For example, Goulding (1997, p.144) states: "If learning is influenced by social, affective, and cognitive dimensions then teachers clearly have to attend to all these factors in the classroom in creating learning opportunities for pupils." The teaching and learning of school Mathematics, in particular, is complex because it is influenced by several factors. For example, Sanders (1994, p.29) mentions that teaching of Mathematics can take a variety of forms because of the different views about how to learn Mathematics, as well as the diverse nature within Mathematics education circles. The integration of teaching and learning Mathematics, therefore, becomes an important feature in this discussion. Jaworski's model (1994) of investigative Mathematics teaching (see Fig. 2.2) referred to as a 'Teaching Triad' gives a good explanation of the relationship between teaching and learning Mathematics. The model was designed after a lengthy observation in Mathematics classrooms "as a device to aid characterization of an investigative approach to Mathematics teaching" (Jaworski, 1994, p.183), with teachers for whom:

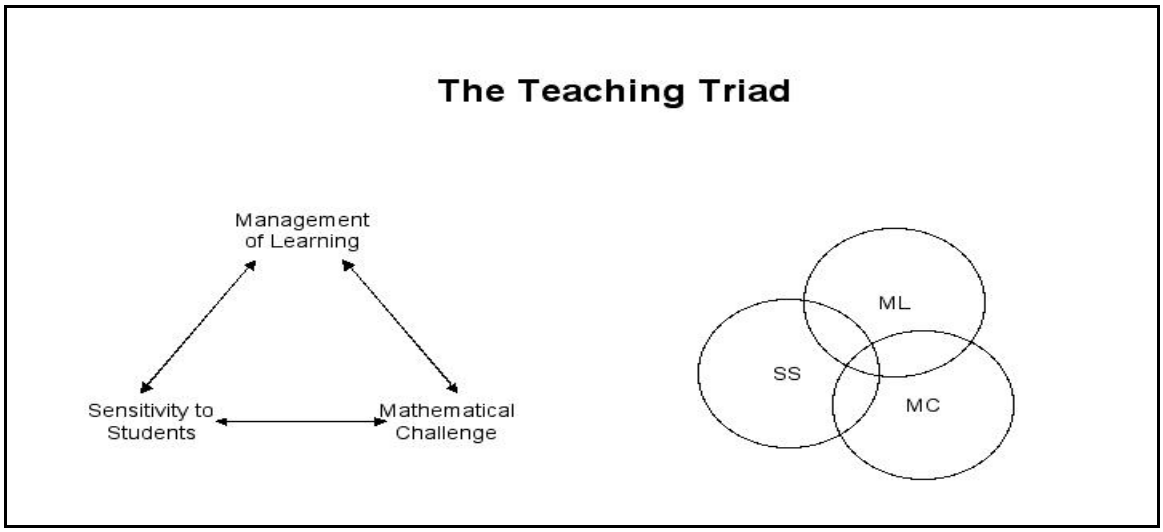


Fig 2.2 The Teaching Triad [from Jaworski (1994, p.107)]

- *Management of learning* is manifested in a set of teaching strategies and beliefs about teaching which influence the prevailing classroom atmosphere and the way in which lessons are conducted.
- *Sensitivity to students* is inherent in the teacher-student relationship and the teacher's knowledge of individual students and influence ways in which the teacher interacts with, and challenges, students.
- *Mathematical challenge* arises from teachers' own epistemological standpoints and the way in which they offer Mathematics to their students depending on students' individual needs and level of progress.

Jaworski (1994, p.107) does not provide a detailed account of the inter-linkage and/or inter-relationships of the three domains but her description of the characteristics of observed Mathematics classrooms sum up the following features:

- Type of tasks which teachers set for students to work on;
- Introduction of a task by the teacher to the students;
- Emphasis on mathematical thinking processes;
- Organization of classroom -groups – and discussions;
- Use of apparatus or equipments: practical work;
- Mode of operation of teacher;

- Student activity and behaviour and
- Teacher evaluation of learning, feedback for planning (p.171).

Although Jaworski (1994a) supports constructivist teaching in Mathematics, she further claims that the social dimension contributes significantly to individual student's construction of meaning (p.218). The social aspect in Mathematics teaching is one of the major components of this study in terms of social constructivism and Learner-Centred Education. Moreover, Jaworski (1994a, p.218) states that constructivism (social) is a philosophy that underpins much of what is regarded as good practice in Mathematics teaching and learning. However, the diverse and obscure nature of Mathematics (Goulding, 1997) could influence ways in which both teachers and educators approach the teaching of Mathematics. According to Jarworski (1994) and Ernest (1989), Mathematics as a subject allows learners the opportunity to construct their own knowledge and understanding. However, "Teaching Mathematics is difficult, particularly if it is based on a constructivist perspective" (Jaworski, 1994a, p.230).

Summary

This chapter describes the historical background of Learner-Centred Education. It describes the implementation of curriculum as discussed by Fullan (1991), Orstein and Hunkins (1993) and others. Review of related literature addressing curriculum implementation in other countries as well as in Namibia specifically is given. The chapter also addresses curriculum reform and policies globally, then nationally. The last section discusses the approaches to Mathematics teaching and learning in relation to the LCE concept. In summary, a theoretical conclusion that social constructivist theory supports

and forms the basic foundation of the concept Learner-Centred approach is drawn from the literature review. The next chapter addresses the methodology and methods used to collect and analyse the data.

Chapter 3

METHODOLOGY AND RESEARCH DESIGN

3.1 INTRODUCTION

The previous two chapters addressed the aims and the theoretical framework for this study, respectively. The main concepts within the theoretical framework advocate curriculum implementation and Learner-Centred approaches in a social constructivist context. The purpose of this study was to investigate the nature and extent of classroom teaching practices for a Learner-Centred Mathematics curriculum in Namibia.

3.2 RESEARCH DESIGN

The classroom environments where the data were collected present a dynamic complex situation because people (teachers and learners) are unique individuals with varying moods and behaviour. Therefore, in order to understand the nature of classroom teaching practices, I have argued for a qualitative research design. Merriam (1998) defines qualitative research as:

> An umbrella concept covering several forms of inquiry that help us understand and explain the meaning of social phenomena with as little disruption of the natural setting as possible. Other terms often used interchangeably are naturalistic inquiry, interpretive research, field study, participant observation, inductive research, case study and ethnography (p.5).

McMillan and Schumacher (2001, p.395) also describe qualitative studies as important investigations for theory generation, policy development, educational practice improvement, illumination of social issues, and action stimulus. This study presents a

qualitative research that involved eight weeks of fieldwork investigations of secondary school Mathematics teachers' classroom practices. Specifically, the study utilized multiple case studies (Glesne, 1999; Merriam, 1998) where three Mathematics classrooms were observed.

Case studies, as some of the common types of qualitative research in education, are defined by Freebody (2003) as follows:

> Case studies focus on one particular instance of educational experience and attempt to gain theoretical and professional insights from a full documentation of that instance. Researchers in a variety of professional and practical domains use case studies as a way of conducting and disseminating research to impact upon practice, and to refine the ways in which practice is theorized (Freebody, 2003, p.81).

According to Merriam (1998):

> A case study design is employed to gain an in-depth understanding of the situation and meaning for those involved. The interest is process rather than outcome, in context rather than a specific variable, in discovery rather than confirmation. Insights gleaned from case studies can directly influence policy, practice, and future research (p.19).

Cohen, Manion and Morrison (2000) explain the purpose of a case study as follows:

> A case study provides a unique example of real people in real situations, enabling readers to understand ideas more clearly than simply by presenting them with abstract theories or principles. A case study can enable readers to understand how ideas and abstract principles can fit together. Case studies can penetrate situations in ways that are not always susceptible to numerical analysis… Furthermore, contexts are unique and dynamic, hence case studies investigate and report the complex dynamic and unfolding interactions of events, human relationships, and other factors in a unique instance (p.181).

Because each classroom presents a dynamic environment with learners and teachers that possess different characteristics, I decided to use multiple case studies that are descriptive in nature. Gay (1992, p.217) suggests that the descriptive method is useful for collecting

data that determine and report the way things are. In order to describe the nature of each classroom in its natural setting, I used classroom observations and interviews for collecting data. I also used a video camera to record the events as they happened in the classrooms. According to Wragg (1994, p.55), "The study of classrooms in what are often termed 'naturalistic' settings means that the observer tries to see life as it really is."

The descriptive case studies in this research were of explanatory nature because one purpose of the research was to describe and explain the patterns of Learner-Centred teaching in relation to teachers' classroom practices. McMillan and Schumacher (2001) distinguish between descriptive exploratory and descriptive explanatory case studies as follows:

> The research purpose of exploratory is to examine 'new' or little known phenomena; discover themes of participant meanings; and develop in detail a concept, model, or hypothesis for future research. Explanatory, on the other hand, describes and explains the patterns related to the phenomena and identifies relationships influencing the phenomena (p. 397).

This study is of explanatory nature because it describes and explains the Learner-Centred patterns in the three Mathematics classrooms.

3.3 RESEARCH METHODS

3.3.1 Sampling

As with most qualitative methods, the sample in this study was small. It consisted of the learners and the teachers of three classrooms from three senior secondary schools in Windhoek city. I selected the schools first before identifying the classrooms to be observed using the following criteria:

1. The school should be a senior secondary school because the emphasis of this study is on senior secondary schools.

2. The school should have a Mathematics teacher who is willing to work with me for a period of two to three consecutive weeks.

3. I preferred to observe Grade 11 classes instead of Grade 12 classes because during the time of data collection most Grade 12 classes were preparing for end of year external examinations.

4. If more than two Grade 11 Mathematics classes were available, I asked the teacher to decide which class he or she preferred observed during my visits. However, once the classroom was chosen no swopping of the learners was allowed between the data collection sessions. This means, I observed the chosen class for consecutive lessons before I moved to the next school and chose another class.

In the end, three Mathematics teachers, two females and one male were observed teaching Grade 11 classes in the three government schools. The government schools were chosen because they enroll a majority of learners compared to private schools and as such show better the reality of classroom situations in Namibia.

3.2.2. Instruments

Classroom observations and videos

As a non-participant observer, I carried out classroom observations during the second school term in June until September 2005. Bottorf (2004, p.752) describes non-participant observation as a situation where "researchers focus primarily on the task of observation, while minimizing their participation in interactions in the setting." I used a video camera to capture maximum classroom activities and participation of both the teacher and the learners. This information from the video formed the main source of data in this study. Bottorf (2004, p.753) explains that "video cameras are used to capture behaviour of interests...video recording provide a rich data source for studying interaction pattern..." However, Babbie (2001) states:

> Even tape recorders and cameras cannot capture all the relevant aspects of social processes. Consequently, in both direct observation and interviewing, it is vital to make full and accurate notes of what goes on (p.295).

I observed one Mathematics classroom at a time for a period of at least 2 weeks. The actual time span of observations was determined by the length of the topic observed. As a non-participant observer, I sat at the back of the classroom and recorded the events with a video camera. Erickson (1992, p.212) cautions about the use of video camera as follows:

- Before taping, explain the purpose and get written or oral consent from those concerned.
- Be aware that people fear videotaping because it might blow their cover instantly.
- With audiovisual recording, confidentiality is the ethical issue that seems most conspicuous.

Semi-structured interviews

Hitchcock and Hughes (1995) define a semi-structured interview as

> A more flexible version of the structured interview. It is the one which tends to be most favoured by educational researchers since it allows depth to be achieved by providing the opportunity on the part of the interviewer to probe and expand the respondent's responses...The interviewer asks certain major questions of all respondents, but each time they can alter the sequences in order to probe more deeply and overcome tendency for respondents to anticipate questions (p.157).

Pring (2000) describes semi-structured interviews by stating that:

> Interviews will be only semi-structures because otherwise there would not be the scope for those interviewed to expand the full significance of their actions...The good interviewer is able to draw out from the person interviewed the deeper significance of the event, so much that it seems ever more difficult to generalize... (p.39).

I arranged interviews with the three Mathematics teachers towards the end of the observation sessions. I used a semi-structured interview guide because it allowed me to probe more and to ask specific questions for the interviewees that relate to their unique situations. Well-conducted interviews are very important in research, because they result in a much higher response rate than questionnaires and can also produce in-depth data not possible to get using questionnaires alone (Gay, 1992; Hittleman and Simon, 1997 and McMillan and Schumacher, 2001). I used an audio-tape recorder during these interviews in order to capture most of the conversation as accurately as possible. Moreover, the tape recording of the interview sessions has an advantage of producing the most complete record of what was said (Hitchcock and Hughes, 1995, p.170). Walford (2001, p.95) says that "Tape-recording has the effect of turning an ephemeral spoken event into a relatively stable object."

Field Notes

Maykut and Morehouse (1994, p.73) describe qualitative researcher's field notes as documents that contain what has been seen and heard by the researcher, without interpretation. In this study, I took field notes everyday after leaving the field in order to capture important features as they were seen and heard at the site of data collection. Patton (1990) emphasises the importance of field notes by stating that:

> Field notes contain the description of what has been observed. They should contain everything that the observer believes to be worth noting. Don't trust anything to future recall... If it's important enough to be part of your consciousness as an observer, if it's information that has helped you understand the context, the setting, what went on, and so forth, then as soon as possible that information should be put into the field notes (p.239).

Patton (1990, p.239) also explains that qualitative field notes are descriptive in nature and they should, therefore, be dated and recorded with basic information such as place of event, who was present, the physical settings, what social interactions took place, and what activities occurred. The field notes helped me when I needed to return to the site for additional data collection. Moreover, the field notes together with videotape lessons and documents provided the information that could be used to check the congruity of Learner-Centred activities in the classrooms.

3.4 PILOT STUDY

3.4.1 Purpose and sample

Purpose

A pilot study was conducted prior to the main data collection. According to Gall, Borg and Gall (1996, p.65) a pilot study "involves small-scale testing of the procedures that you plan to use in the main study, and revising the procedures based on what the testing reveals." Consequently, I conducted a pilot study during the second term of the 2004 school year at a senior secondary school in the same region as the schools chosen for the main study.

The pilot study assisted me in testing the research instruments and designs in order to: (1) provide feedback that will aid me in revising questions in the guide that are apparently unclear, do not solicit the desired information, or produce negative reactions in subjects (Gay, 1992, p.233); (2) determine whether the procedure I used had merit and to correct obvious flaws (Gall *et al*. 1996, p.65); (3) acquaint and familiarize myself with the use and technical handling of some equipment such as video cameras and tape recording; (4) collect data to establish the reliability of the instruments in order to improve their constructs, features, qualities and sensitivity; and (5) alert me to elements of my own interviewing techniques that support the objectives of the study and to those that detract from the study objectives (Seidman, 1991, p.30).

3.4.2 Procedures, instruments and analysis

The following procedures were used to gain access to the school as well as to enable me to visit the classroom:

1. I received a letter of permission to visit the school from the Regional Director in the Ministry of Education and immediately arranged appointments to visit the school management and the teachers.
2. I confirmed the appointments with Mathematics teachers and visited the schools in order to: (i) brief the teachers about the format and procedure of the class visits and an interview; (ii) check classroom settings with permission from the Headmaster of the school and the teacher; (iii) revise research procedures (if necessary) and adjust the order and phrasing of interview questions; (iv) develop a way of organizing, coding and retrieving collected data for preliminary data analysis and (v) with ethical and legal consequences in mind, assured the participants of the anonymity of their responses, that the videotapes and audiotapes will not be used for other purposes than those they are intended for and the teachers' names will not be identifiable in the final report; instead aliases will be used.

The data from the pilot study were collected using a Learner Centred Education Monitoring Scale (LCE-MS) (see Table 3.1) and a semi-structured Teacher Interview Guide (TIG). I was assisted by a colleague from the Media Centre at the University of Namibia (as a research assistant) with recording of the lessons using a video camera while I sat at the back of the class and administered the LCE-MS instrument. I also wrote down some notes to elaborate on certain events that happened during classroom teaching. I conducted an interview at the end of the two weeks sessions using a TIG and a tape recorder, then analysed the data from the LCE-MS manually by adding up tallies of

incidences as noted on the monitoring scale. The video tape lessons and the interview session were transcribed verbatim.

3.4.3 Evaluation of the pilot study

The pilot study offered important and necessary experience to me in doing fieldwork. For example, I learned technical procedures such as how to handle a tape recorder in front of the interviewee in such a manner that I don't make the interviewee too much uncomfortable. It was also the first time for me to transcribe video lessons and this proved to be a challenge.

The Learner Centred Education Monitoring Scale (LCE-MS)

The LCE-MS was designed as shown in Table 3.1 below and it was used as a checklist during classroom observation.

Table 3.1: Learner Centred Education Monitoring Scale

Learner-centred approaches	**Teacher-centred approaches**
Teacher relates to learners' experience	Not relate to learners' experience
Use of group work/pair	Whole class call response
Teacher gives appropriate feedback	No feedback/inappropriate
Teacher responds to both correct and incorrect answers from learners	Teacher ignores learners' questions
Use of teaching aids	No teaching aids available
Learners use manipulatives	No manipulatives available
Learners are engaged investigative tasks	No meaningful tasks for learners
Learner-learner interactions	No interaction between teacher and learners
Teacher-learner interactions	Teacher controlled interaction
Teacher asks more 'why, explain' questions	Teacher asks more recall questions
Gender balance	Gender bias

Discussion with the supervisors of my study about the pilot study results of the LCE-MS revealed three main problems:

1. The content validity was very poor because the instrument did not reasonably and comprehensively cover the main domains that it was supposed to cover (Cohen *et al*., 2000, p.109).

2. The reliability of the instrument (due to subjectivity) would be low since it was not clear when and how I decided on the extent of rating whether the teacher was balancing learner-centred and teacher-centred approaches or was one of the extremes.

3. The instrument was comparing learner-centredness with teacher-centeredness rather than measuring the extent to which Mathematics teachers practice learner-centred approaches in the classroom – the intended objective. Therefore, using this instrument would change the focus of the study. Advice was given to design another instrument. A portion of this instrument, adapted from Adler, Lelliot and Slonimsky (1997) is given in Table 3.2 on the next page.

Table 3.2: Classroom Observation Checklist

In the checklist below, mark the box (circle the number) which best reflects your observation of the teachers' practices. Where necessary make additional comments on your observation.

A. INTRODUCTION

Lesson Introduction

1	2	3	4
No introduction, i.e. no connection is made with previous lesson. No direction for new lesson. No greetings.	Links with past lesson but no real focus for present lesson.	Links with past lesson and clear focus for present lesson.	Lesson is clearly contextualized and learners' interest is aroused. Attention is focused.

COMMENT (Was the lesson appropriately introduced?) ……

B. PRESENTATION & RESOURCES

B1. EXPLICIT ORGANISATION OF GROUP WORK

1	2	3	4
No group work.	Only two or three learners interact. Others just listen.	Group of learners with limited interaction/interact when teacher motivates.	Groups of learners discuss problems, questions and activities by themselves.

COMMENT (Does the organization relates to the type of lesson?) ……

B2. LEARNER-LEARNER INTERACTION WITHOUT TEACHER

1	2	3	4
Learners don't question each other or probe for details.	Learners question each other in secret because this is not allowed/encouraged by the teacher.	Learners only question or help other learners when prompted to do so by teacher.	Learners freely enter into discussions with each other.

COMMENT (Frequency): ……..

[Adapted from: Adler, J, Lelliot, T. and Slonimsky, L. (1997)]

I tested the instrument (above) using the recorded video lessons from the pilot study. Several weaknesses in this instrument that were worth taking into consideration surfaced: First, the instrument did not have a consistent rating scale. Second, the sections that represent different classroom activities were categorized to the extent that it was difficult for me to do the rating consistently. Third, the instrument was too long. It covered ten pages. This made the recording procedure very difficult because I had to page through several items before locating the required item. Therefore, consistency was minimal if not absent. Fourth, I started doubting the internal validity of the instrument. The question of how congruent the findings would be with 'real issues' (Merriam, 1998, p.201) and whether I was really measuring what I wanted to measure became crucial.

At that stage, I gave a brief presentation at a seminar for PhD students at the University of Western Cape, Cape Town in 2004 about my pilot study. I presented a 10 minute video clip and asked the participants to write short vignettes on the clip. This session of wider public scrutiny highlighted the following issues:

1. The research instrument should have at least three Learner-Centred dimensions derived from literature (excluding teacher-centeredness).

2. I should come up with indicators for each Learner-Centred dimension in order to guide my decisions during data collection periods.

3. I should tally the occurrences of the events I observed.

Below is a portion of an example of what I now renamed the 'Lesson Observation Schedule' (LOS). The full text of the LOS instrument is given in Appendix A.

Table 3.3: Lesson Observation Schedule (LOS)

LCE Dimensions (derived from literature)	**Indicators**	**Occurrences** (use tally)	**Comments** (on what is going on)
A: Learners' **active** involvement in lesson	1. Learner-learner interactions		
	2. Teacher-learner interactions		
	3. Learner initiated questions		
B: Learners' experiences are used	1. Reference to daily life experiences		
	2. Connections to other subject areas		
	3. Connections to prior math knowledge		

The indicators in Table 3.3 above were selected from the literature review in Chapter two. I decided to use related literature (MBEC, 1999; McCombs and Whisler, 1997 and Roesler, 2002) on Learner-Centred Education as a guide for features that address learners' behaviours and characteristics in a Learner-Centred classroom.

Using the video lessons from the pilot study, I tested the LOS instrument in order to validate the constructs as well as content validity of the instrument. In order to determine the instrument's consistency two lessons from the pilot study were coded more than once (i.e., by viewing the lesson more than once). Through repetitions of watching recorded video lessons, I found the variations in coding to be minimal. However, I kept in mind

that the reliability of qualitative data can be improved through triangulation (Merriam, 1998; Cohen *et al*., 2000). Moreover, Cohen *et al.* (2000, p.129) highlight several threats to validity and reliability in observations that include among others: (1) the researcher's unawareness of important antecedent events and; (2) the reactivity effect due to the presence of the observer. I took note of the points discussed above and remained open to make necessary adjustment to the instrument as the need arose.

The Teacher Interview Guide (TIG)

The TIG was semi-structured; therefore it was easy to modify and adjust the structure and content of the interviews accordingly during the pilot and the main study. The transcribed data from the pilot study, however, revealed that: (1) sometimes I was too impatient to allow the interviewee more time to finish the talking and; (2) I had a tendency to finish off the sentences for the interviewee by making assumptions too quickly. I, therefore, minimized these weaknesses during main data collection by noting down reminders next to the TIG items.

3.5 PROCEDURES FOR THE OBSERVATION OF CLASSROOMS

In order to get informed consent, I used the same collection procedures as those used for the pilot study in order to gain access to the schools and the classrooms. After I finished transcribing the interviews and the first two video lessons for each participant, I gave the participants copies for cross checking.

3.6 DATA ANALYSIS

I started data analysis and coding during the first phase of data collection. That is, when I finished observing the first school, I started transcribing the lessons and analysed them

immediately. This procedure allowed me to make necessary adjustment and improvement on the instruments and on the data collection procedures. However, the adjustment on the instruments improved the reliability of the data collection procedures. In the meantime, I proceeded with data collection for the remaining schools. Moreover, by improving my data collection procedures, the data collected towards the end (especially the last school) were richer with information than the first data, therefore, the improvement was worthwhile.

3.6.1 Video transcripts

First, I transcribed the video-taped lessons verbatim. Then I read and re-read the transcribed lessons several times in order to make sense of the raw data. I formulated categories for specific themes as they emerged from the lessons, see Table 3.5 below. In order to check for consistency or reliability, I revisited the analysis categories after some weeks or months and verified whether the coding was still consistent with the initial coding system. Where adjustments were made, it was done by going through all the documents once more.

Reliability refers to "the extent to which any particular method of data collection is replicable" (Hitchcock and Hughes, 1995, p.107). It is also defined to mean "dependability or consistency" (Neuman, 2003, p.178). In qualitative research, reliability can be described as a match between what the researcher records as data and what actually happens in the natural setting that is being researched (Bogdan and Biklen, 1992 *cited in* Cohen *et al*., 2000, p.119). Yet, some researchers believe that replication of qualitative studies is difficult if not impossible because naturalistic studies include

situations that are unique and idiosyncratic (LeCompte and Preissle, 1993 *cited in* Cohen *et al.,* 2000, p.119).

Neuman (2003, p.184) cautions that it is difficult and uncommon to have perfect reliability in one's study, especially qualitative study processes that are unstable over a period of time. Hence, Neuman has proposed four ways to increase the reliability of measure: (1) clearly conceptualize constructs, (2) use a precise level of measurement, (3) use multiple indicators, and (4) use pilot tests. I addressed the issue of reliability by conducting a pilot study and by revisiting the coding schemes several times (after some weeks and months) and by checking the consistency of the coding.

For this research, I addressed the issue of validity by using descriptive and interpretive validity in Chapters 4-5. That means, for descriptive validity I used the extracts from the raw data to describe the analysis procedures and for interpretive validity I used evidence from the video transcripts and the verbatim transcribed interviews to interpret and give meanings of the events as stated by the participants themselves. The evidence was further used to catch the meaning and interpretations of events in the Mathematics classrooms and to construct descriptive categories or themes.

Maxwell (1992) *cited in* Cohen *et al*. (2000, p.107) describe descriptive and interpretive validity in qualitative methods as follows:

- *Descriptive validity* is the factual accuracy of the account that is not made up, selective, or distorted. It is the notion of 'truth' in research – the notion of what actually happened;
- *Interpretive validity* is the ability of the research to catch the meaning, interpretations, terms, intentions that situations and events or data have for the participants/subjects themselves in their terms.

The term validity means "trustworthiness of inferences drawn from data" (Eisenhart and Howe, 1992, p.644). Neuman (2003, p.185) describes it as "the bridge between a construct and the data." According to Bless and Higson-Smith (1995, p.129) the term validity is "concerned with just how accurately the observable measures actually represent the concept in question or whether, in fact, they represent something else."

Recently, the term validity has been defined more broadly than the earlier versions that described validity as a demonstration that a particular instrument is valid if it measures what it purports to measure (Cohen *et al*., 2000, p.105). They explain that validity in qualitative research can be addressed through the truthfulness, depth, richness and capacity of the data achieved, the participants approached, the extent of triangulation, and the disinterestedness or objectivity of the researcher (p.105).

3.6.2 Interview transcripts

I transcribed the audio-tapes for interviews verbatim. I read the scripts over and over in order to identify incidences that matched the discovered categories from the observed

lessons. I was reflexive because I conducted verification of initial findings and maintained a self-critique during data analysis procedures.

According to McMillan and Schumacher (2001), reflexivity is defined broadly as a concept that

> includes rigorous examination of one's personal and theoretical commitments to see how they serve as resources for selecting one of several qualitative approaches, framing the research problems, generating particular data, ways of relating to participants, and for developing specific interpretations (p.411).

Cohen *et al.* (2000, p.141) explain that because reflexivity recognizes that researchers are part and parcel of the social world that they research, they bring their own life history to the research situation and participants are likely to behave atypically in their presence. Cohen *et al*. (ibid) also caution that highly reflexive researchers should be acutely aware of the ways in which their selectivity, perceptions, background, and inductive processes and paradigms shape the research (p.141). During data presentation and data analysis I addressed reflexivity as much as possible by recording data procedures, decisions and actions that I made in terms of data presentation and discussions before making concluding remarks.

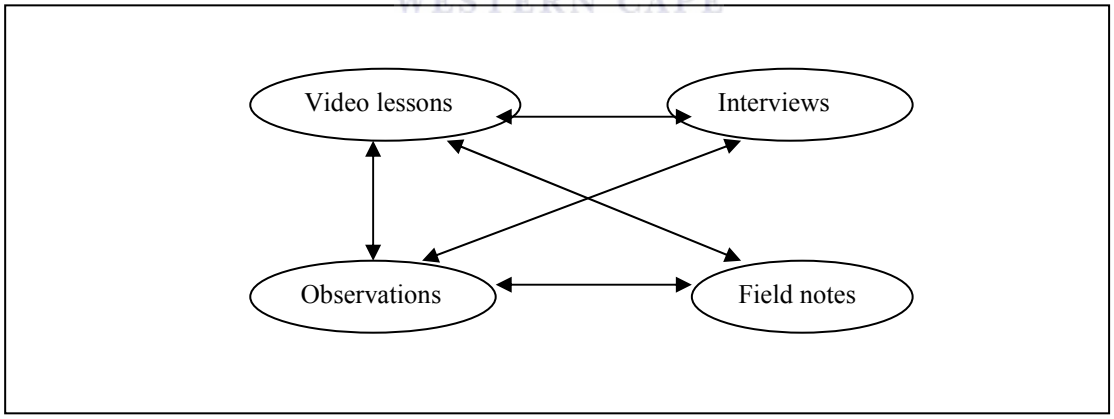
3.6.3 Triangulation

The term triangulation is a borrowed concept from surveyors and sailors to describe a process of looking at something from different viewpoints (Neuman, 2003, p.137). Cohen *et al*. (2000, p.112) defines triangulation "as the use of two or more methods of data collection in the study of some human behaviour." That means the term is frequently used to express the way researchers view their methods and methodologies in more than one way. Neuman (2003, p.137) for example, describes different types of triangulation:

Triangulation of observers: Multiple observers add alternative perspectives, backgrounds, and social characteristics and tend to reduce the limitations of one observer bias. In this study, although I used a video camera during classroom observations, I was the sole observer. Therefore, this study has the shortcoming of not using multiple observers during data collection.

Triangulation of method: Could mean to combine qualitative and quantitative styles of research and data. This study did not use mixed qualitative and quantitative methods but instead it used multiple data-collection procedures that include observation, videotaping, interviews and other supporting documents. Figure 3.1 below summarizes the triangulation process in this study.

Figure 3.1: Data triangulation



Summary

This chapter described the research methodology and design used in this study. A video camera was used to record a total number of 22 Mathematics lessons at Grade 11. The

video transcripts formed the main source of data in this study and were transcribed verbatim. Transcribed interview scripts were also used to support data findings. Issues of validity and reliability were addressed through a pilot study. The chapter also discussed ethical issues related to data collection and procedures. The next chapter presents detailed results of the study.

Chapter 4

STUDY RESULTS

4.1 INTRODUCTION

This study comprises case studies of Mathematics classes at three Secondary schools. In this chapter, I first present an ethnographic description of the schools' setting and the teachers. These descriptions will enable the reader to familiarize him or herself with the environment where the data were collected. Second, I present the data generated from the study and explain the themes or the categories as they emerged from the data in relation to the research questions.

4.2 CLASSROOM CONTEXTS

4.2.1 Classroom A

Classroom A (in School A) was situated in one of the old senior secondary schools in Katutura location in Windhoek city. During the colonial rule era, Katutura was designated a black township. A majority of the learners in this school A came from low to middle-income groups. Classroom A belongs to Ndapwa (a pseudo name), a Grade 11 Mathematics teacher in her mid- thirties. She has arranged the desks and chairs in the classroom in two rows with the learners sitting facing each other. Her table was at the back of the classroom. There was a closet in the front corner next to the chalkboard. During the interview session, Ndapwa said that she liked this kind of seating arrangement because it made her class look neat and she expected learners to push back their chairs under the desks every time they leave the classroom.

All the classrooms had intercoms; hence the headmaster or the secretary would now and then give announcements and instructions through the intercom during teaching time. Some of these announcements were disturbing for me especially when the teacher ignored them and continued talking. There were 38 learners in class, eighteen boys and twenty girls. Learners moved from one class session to another as a matter of routine in most schools in Namibia. The class that I observed was mostly arriving 10 minutes late for Ndapwa's period because sometimes the other teacher kept the learners for too long. Ndapwa complained about the late arrival because her period was shortened but it gave me enough time to set up my video camera and a chance to talk to her before the class started.

4.2.2 Classroom B

Classroom B belonged to Wetu (a pseudo name) and it was one of the Grade 11 classes at School B, also in Katutura location in Windhoek city. A majority of the learners in this school came from low to middle-income groups. Wetu was a young Mathematics and physical science teacher in his mid-twenties. His classroom was situated upstairs in the first block from the main entrance. This classroom was a laboratory, and since Wetu also taught Physical Science he was assigned this classroom for all his classes. There were fixed cardboards around the laboratory and a tall bench in front for the teacher. The laboratory had a fume cardboard in the left corner next to the teacher's bench. There were a few instances when Wetu stood behind the fume cardboard and I could not capture him with my video camera. Wetu did not talk loudly and had a tendency of standing behind the bench most of the time. This habit made it sometimes difficult for me to hear him. Hence, my video camera was always adjusted to maximum volume during recording

time. There were 30 learners in class, fifteen boys and fifteen girls. The learners used normal chairs and desks like in an ordinary classroom. The desks were arranged in haphazard rows close to one another. This kind of arrangement made the classroom look overcrowded. In order to avoid drawing too much attention, I sat at the back of the classroom. Learners would also rotate for different class sessions like at school A. The school had an intercom system like School A that I visited earlier and Wetu would stop talking when announcements came through the intercom from the headmaster's office.

4.2.3 Classroom C

Classroom C belonged to teacher Nuusiku (a pseudo name), a Grade 11and 12 Mathematics teacher at a senior secondary school in a Windhoek suburb. Most learners in this school C also came from Katutura location. Classroom C was situated in one of the blocks at the back of the school away from the main entrance. Teacher Nuusiku had 35 learners in the Grade 11A, sixteen boys and nineteen girls. The classroom was big and, therefore, it was not overcrowded. The desks and chairs were arranged in five vertical rows. The teacher's table was at the back of the classroom but Nuusiku stayed in front of the classroom most of the time when she taught. There were cardboards fixed to the wall at the back of the classroom as well as filing shelves on the other side opposite the teacher's table. Like Wetu, teacher Nuusiku paid attention to the announcements that came through the intercom.

4.3 DATA PRESENTATION

This section presents the data according to the research questions. It also describes how the numerical and other frequency counts in Table 4.2 - 4.4 were arrived at. The first research question was, "*What is the nature of classroom teaching practice for a Learner-Centred Mathematics curriculum in Namibia*?" In order to answer this question, first a description of the nature of classroom teaching practice is given in this section. Second, the description that provides explanations of frequency counts for the teacher and the learners' involvement in the lessons using selected classroom episodes is also provided. Three samples of transcribed lessons are given in Appendix E.

4.3.1 The nature of classroom practice

In this study, the term '*nature* of classroom practice' is defined in the context of three attributes namely, *teacher*, *learner* and *classroom* to explain the interaction practices between the teacher and the learners and between the learners and learners themselves. The teacher is mentioned first because she or he plays an important role in any teaching and learning situation. Cornelius (1982, p.37) noted this a few decades ago when he stated that "inevitably the key to good, successful learning of Mathematics is the *teacher*". Specifically, in Learner-Centred Education the teacher is regarded as a mentor and facilitator of learning. The teacher is the implementer of the 'taught' curriculum.

The second attribute in the description of the nature of classroom practice is the learner. She or he is put in the middle (the centre) to emphasise the notion of putting the learner at the centre in a learner-centred context. It is, therefore, imperative that the classroom be also taken into consideration as an important element of this definition because both the

teacher and the learner do not exist in a vacuum. They need a physical environment (classroom) that is conducive to learning. According to Kyriacou (1997, p.111), "An effective classroom climate is one in which the teacher's authority to organise and manage learning activities is accepted by the pupils; there is mutual respect and good rapport and the atmosphere is one of purposefulness and confidence in learning."

The teacher in this context is described in terms of classroom management, teaching strategies (methods) used as well as the kind of interactions involved with the learners. Likewise, learners are described in terms of their dispositions towards learning and how they use the resources, including those provided by teachers in their actions. The context of a classroom is described in terms of seating arrangements, number of learners present in class, facilities, and resources available. Table 4.1 below provides a summary of the descriptions given above.

Table 4.1: Nature of classroom practice for learner-centredness

Attributes	**Characteristics**
Teacher	Classroom management strategies. Teaching strategies or methods used. Interaction with learners.
Learner	Learners' dispositions such as responses to teacher requests and invitations to participate; doing tasks given to them; seeking further information on their own by initiating discussions; sharing information with peers.
Classroom	Seating arrangement. Adequacy of space. Appropriate resources that stimulate learners' interest.

4.3.2 Learners' involvement in the lessons

This section forms the main theme that presents and describes the teacher and learner and learners' involvement in classroom discourse during lesson presentations. This involvement includes instances of verbal and non-verbal communication between the teacher and the learners and between the learners themselves. Chorus answers by the learners, affirmations and negative utterances by either the learners or the teacher were noted down. However, any conversation that was irrelevant to the lesson content was ignored. For example, when a teacher reprimanded a learner for late arrival or when the class discussed issues about soccer or politics, these cases were excluded from this category. However, if a learner was reprimanded about not doing his or her homework, that part of discussion was considered relevant to class content.

The extract below was taken from the middle of Lesson Number 2 in Classroom A and it showes teacher-learners' involvement in the lesson. The teacher first gave a class activity and asked the learners to do individual work. She then checked learners' work by going over the solutions with the class giving chorus answers. In this extract, 24 classroom interactions between the teacher and learners were counted. For example, line number one which starts with the teacher as an initiator of conversation up to line 3 (boy 6 and 7) was counted as one instance of communication. This extract does not contain interaction between the learners. It is important to note that the last three phrases (lines 37 to 40) were not counted because after boy11's indication of willingness to ask something, the teacher ignored his request and continued with the lesson.

Description of the transcriptions

( )	Observer's comments
!	Emphasis on the tone in the speech
….	Words undeciphered
…	Indicates incomplete sentence(s)
Boy or girl 1, 2, 3, etc.	Indicate sequence of events
Tomas, John, etc.	Pseudo names given to learners

Extract from Classroom A: Lesson 2 (Algebra)

Teacher: 7x – 3x is 5x. One mark for that one, if you got it right. Then, the next one; positive 4y plus 3y is what?

Boys 6 & 7: Seven (*boys talked simultaneously*)

Teacher: 7y – 8y, Positive 7y minus 8y gives you, what?

Girl 1: Negative one.

Teacher: Negative one, but we know that we don't write the one, but we just write the y. (i.e. we don't write (-1)y but –y). So if your answer is negative y then you give one mark to that one. One mark for this people, if you got it wrong then make it wrong and then write the correct answer with the pencil. The next one, question number c. First, they put all the a's together so that we first look at positive 4a and one (a) gives us what?

Boy 8: Two

Teacher: Positive 4, the ones with positive sign. The positive 4… (teacher pointed at the calculations on the chalkboard) and positive one gives +5.

Class: Positive 5 (most boys on the right-hand side of the classroom shouted the answer).

Teacher: Positive 5a. And then we have negative 2a -2 gives you what?

Class: Positive 3

Teacher: Positive 3. So the first answer that you need to write there (teacher referred to the number above) is positive…

Class: Three

Teacher: You don't have to write a plus (+) sign, you just write 3. So it gives you 3a. Then, we go to the b's, the letters with the b's. We have negative two and another negative two *b* gives you …?

Boy 9: Positive 4

Teacher: Negative 4 people! (with emphasis). If the signs are the same we just ad the numbers together. So, a negative 2 and a negative 2 gives you…?

Class: Negative 4! (with emphasis).

Teacher: Negative plus 3…?

Boy 10: Negative one.

Teacher: Negative 4 (teacher repeated the sentence*)?* Negative 4 plus 3?

Boy 10: Sorry…?

Teacher: Gives you negative …?

Class: One! (with emphasis).

Teacher: One. If the signs are different? Positive 3 gives you …?

Class: Eight! (with emphasis).

Teacher: Positive 8 minus the … one. Positive 7c and that is your answer for number *c*. So if you have number one, is 6 marks!

Boy 11: Miss? Miss?

Teacher: One, two, four, six marks (teacher counted the ticks on the marked exercise).

[Ndapwa, Classroom A, **07.06.2005**]

The next extract below illustrates a section of the conversation that took place in Classroom B (Lesson 1) after the teacher gave a brief lesson introduction on 'Conversion of Units'. The teacher wrote a class exercise on the chalkboard and proceeded to work out solutions on the chalkboard while the class listened and copied down the solutions. In this extract, 16 instances of 'classroom interactions' were counted. However, unlike in the previous extract above, other variations were taken into consideration. For example, in this excerpt there was learner initiated talk as shown in lines 9, 12, 16, 20, 25 and 27.

Extract from Classroom B: **Lesson 1 (Conversions)**

Teacher: Ok, first of all, convert this (6.4 hrs) into minutes. We know this (teacher
2 wrote 1h = 60 minutes on the chalkboard) and now we have … what is this now in minutes? You cross multiply … 6.4 hours times 60 minutes is
4 equal to 380 …

Girl 2: Three hundred and eighty minutes.

6 Teacher: And then now take this back to hours and minutes. Yes, we know it is 6 hours but what is 6 times … to give you … Therefore, you have this minus
8 … which is … (teacher wrote some calculations on the board).

Boy 4: Is it equal to or equivalent because there are a lot of guys there?

10 Class: (The class laughed)

Teacher: Why is it …?

12 Boy 4: Is it equal to …? The one the …

Teacher: Equal, equal to then you cross multiply.

14 Boy 4: Hoe so? (how?*)*

Teacher: Don't be a movie star. What does equality means?

16 Boy 5: Sir, where did you get 384?

Teacher: 384? I cross multiply 60 by 6.4 because you know that one hour is sixty minutes. Therefore 6.4 hours times 60 is equal to 384 minutes.

Learner: Ooh!

Boy 5: From there?

Teacher: From here, you know already that you have 6 hours then 6. 4 we don't know what is 6.4 hours in minutes. Therefore you multiply this (6.4 hrs) by 60. You have this 360 minutes and then you have this 384 minutes. You subtract to get the number... you have 6 hours …

Boy 6: Sir, we don't understand anything.

Teacher: You don't understand? Mmh? Then let's start this all over again.

Boy 6: Start all over.

Teacher: Ok, one hour is …

Class: 60 minutes [Teacher Wetu, Classroom B**, 30.06.2005**]

The third extract below was taken from the beginning of Lesson Number 1 in Classroom C. It represents one third of this kind of verbal communication between the teacher and the learners for the whole entire lesson. The teacher stated the question number and learners said their answers in turns, row by row. The lesson was about plotting graphs and 34 frequency counts were tallied as 'classroom involvement.' It is also important to note that lines 2 and 13 were counted although the responses were inaudible. However, lines 40 to 41 were tallied as one instance because boy 8 repeated what was said by the other learner (boy 7). The communication between the teacher and the learners went as follows:

Teacher: Example number one …. The … of *a* …?

2 Learner: (said something but inaudible)

Teacher: Ya, … plus. Number b?

4 Boy 1: One and …

Teacher: One; minus one, Ok. If you don't agree keep your hands up and tell me
6 why you don't agree.

Boy 2: Minus …

8 Teacher: Minus three; one. Agree?

Girl 1: Minus two, I think.

10 Teacher: Minus two and? Three, yes. Ok, and …what do you get?

Class: A rectangle.

12 Teacher: A rectangle! What is the difference between a rectangle and a square?

Class: (inaudible)

14 Teacher: What about the sides? Ya?

Boy 3: The Square has all four sides … And the rectangle … and two other equal sides.

Teacher: Yes, the square has 4 equal sides. The rectangle has, we say opposite sides are equal of the rectangle. Example 2, you have to give me coordinates …. PQRST?

Girl 2: Three and two.

Teacher: P, 3 and 2, Ok. Q?

Girl 2: Two …

Teacher: Two and one. R?

Girl 2: One and zero.

Teacher: One and zero. That's correct. You all get that the coordinates …?

Class: (inaudible)

Teacher: Is … on the x-axis and the y coordinates. The S?

Boy 4: Zero and …

Girl 2: Minus one and zero

Teacher: No, is what he said? Say it again.

Boy 4: Zero, negative one.

Teacher: Zero, Negative 1. The x coordinate is zero and then you only move … y axis. So, is zero; negative one (that is, (0;-1)). And T? Don't sleep!

Boy 5: Negative one and negative two.

Teacher: Negative one; negative two, that's correct. I hope you all wrote them I brackets.

Boy 6: Yes

Teacher: Because if I see you not writing them in brackets in an exam or test, I will not give you a mark. And then when you join them, what do you get?

Boy 7: Straight line.

Boy 8: Straight line.

42 Teacher: A straight line. And then you also have to write … number three *a*, where are we now? Here are we. [Teacher Nuusiku, Classroom C**, 08.09.2005**]

Events in Classroom A

This section deals with events in Classroom A. Table 4.2 indicates the frequency counts of the interactions between the teacher and the learners and between the learners themselves. Eight lessons were observed in this classroom. The clarifications and indicators described in the extracts above were used to compile frequency counts of classroom interactions given in all the three Tables 4.2 - 4.4.

Table 4.2: Frequency counts of interactions in Classroom A

Interactions	Time lapse (in minutes)							Total no of interactions
	5	**10**	**15**	**20**	**25**	**30**	**35**	
Lesson 1	0	14	14	13	20	12*		73
Lesson 2	9	44	22	23	36	5	13*	152
Lesson 3	15	14	33	7	10	14	11*	104
Lesson 4	22	9	18	10*				59
Lesson 5	16	21	8	3	1	1	0*	50
Lesson 6	4	6	8	4	5*			27
Lesson 7	4	18	28	7	1*			58
Lesson 8	9	21	6	19	9	3*		67
Total number of classroom interactions								**590**

Note: The asterisk (*) shows the length of the lesson, e.g., Lesson 4 lasted 20 minutes and Lesson 5 lasted 35 minutes but during the last 15 minutes, nothing much happened.

Lesson 1: Ndapwa spent 2 minutes of the lesson on administrative matters such as class register roll calls, distribution of handouts and approximately 3 minutes on lesson introduction. During lesson introduction, she talked non-stop without any interruption. She started to interact gradually with learners during the next 10 minutes by asking questions such as "why are they unlike terms?", "what will you do here?", "do you follow?" As the lesson progressed, the interaction between the teacher and the learners progressed from 14 to 20 frequency counts. The last 5 minutes of the lesson were dominated by chorus answers from the class while the teacher worked out solutions on the chalkboard. A girl asked for the teacher's clarification on how to divide like and unlike terms. The learners were given homework. The lesson lasted 30 minutes instead of 35 minutes.

Lesson 2: During the first 5 minutes, the teacher instructed learners to take out handouts that had been given before. She wrote some problems on the chalkboard and asked the class to keep quiet. The learners did a self-test activity that was given. The next 10 minutes were followed by rigorous teacher-learners' dialogue whereby the teacher worked out solutions to the problems given and asked leading questions, such as "positive five and negative three gives you…what?" or "3x and 4x give us what?" In some instances, individual learners shouted the answers while in some cases the class chorused the answers. After 15 minutes, the class became noisy because learners started talking among themselves. Some learners asked the teacher to explain how she did the calculations. The next 5 minutes were used for teacher-talk (she reprimanded the class for bad behaviour) and the last minutes of the period were spent on a class activity that was done individually. The bell rang while the teacher was starting to write solutions on the chalkboard.

Lesson 3: The learners arrived a little bit late and the teacher used this waiting time to write some exercises on the chalkboard. Hence, the first 5 minutes involved an average teacher-learner talk (question-answer). The class then spent approximately 10 minutes doing a class activity. Learners were asked to work out six mathematical problems. Some learners asked for clarifications, namely "Miss, must we answer or must we just write down…?" After 15 minutes, the teacher called on some learners to say the answers to the problem (33 instances were recorded here). The class was given again 5 problems to do individually and the learners spent almost 10 minutes on these exercises. Then the teacher spent the last 10 minutes working out solutions on the chalkboard with the class giving chorus answers.

Lesson 4: Immediately when she greeted the class, she started the lesson where she left off yesterday. The lesson was about 'factorization'. The communication was much the same like the first three lessons above. For example, question such as, "What must you multiply two with to get give you 2x?" were asked. The class would respond and say "x". Twenty two instances were noted down. After 5 minutes the teacher asked the class to do exercise number 9 and she provided some clues on how to work out the solutions. Ndapwa spent the last 10 minutes of the lesson working out solutions of the problems on the chalkboard as well as explaining the procedural steps of factorization to the class (28 instances were recorded in total). This lesson was very short compared to the other lessons that were observed. It lasted 20 minutes instead of 35 minutes; therefore there was no proper conclusion.

Lesson 5: In this lesson, fifty classroom interactions were counted during data analysis process. An interesting finding was that a lot of communication happened during the first 15 minutes of the lesson. The first 5 minutes were spent on revision exercise. Ndapwa asked learners to explain how to solve for x. Five boys were involved in this discussion. The next 5 minutes were spent on a class activity. Learners were given 2 minutes to work on the exercise given. The other 3 minutes were spent on explanation from the teacher. She worked out solutions on the chalkboard and the class copied the answers. Ndapwa then spent the rest of the period marking learners' worksheets (for work given sometimes back) and she asked learners to do an exercise from the textbook. Therefore, minimum classroom interaction took place toward the end of this lesson.

Lesson 6: The teacher wrote some exercises on the chalkboard while waiting for the class to arrive. Communication during the first 5 minutes was about asking some learners to work out solutions on the chalkboard and giving feedback on the calculation done. Ndapwa spent the next 10 minutes re-working the solutions to the problems and asked learners to copy down the answers. Here and there learners intervened and asked for clarification. For example, one girl asked "Miss, I wanted to ask about example number d?" When the teacher asked Moses (pseudo name) to solve a problem on the chalkboard, he said "I don't know. I don't understand…" Ndapwa wrote more exercise problems on the board and asked some learners (volunteers) to work them out. Most learners started talking among themselves while some just made noise by talking irrelevant things. The teacher helped the learners that were writing on the board with correct procedures. At some point in time, she asked the class to keep quiet, especially when

announcements were being given through the intercom. She worked out all the solutions on the chalkboard while the class asked for clarification here and there.

Lesson 7: The events in the first 5 minutes of this lesson went as follows: Ndapwa spent at least the first two minutes looking for her textbook and the next 3 minutes explaining the methods of substitution and elimination. She continued explaining (while writing on the chalkboard) how to do substitution using two equations with two unknown. Communication went as follows: "Understand?" or "2x plus…3 times 2 is what?" Learners' responses were mostly like "Ok", "Yes" and so on. The rest of the lesson was spent on solving 'simultaneous equations'. The teacher worked out most of the solutions and the class copied them from the chalkboard. After 15 minutes, learners started asking higher-order questions, namely: "Why do we divide with negative 14, miss? Must we always use smaller numbers…?" During the last five minutes of the lesson, Ndapwa introduced the class to the second method of solving for x and y, called the 'elimination' method. She wrote some examples on the chalkboard and the class paid attention to her work. This lesson lasted for 25 minutes instead of 35 minutes. Most activities that were recorded happened between the first 10 -15 minutes of lesson presentation.

Lesson 8: Nine classroom interactions were recorded during the first 5 minutes. These interactions included activities such as teacher calling learners one by one to work out solutions on the chalkboard, learners asking for clarification on the problem given and teacher reprimanding a learner for late arrival. The conversation that followed during the next 10 minutes concentrated on learners' behaviour in the classroom. Ndapwa spent approximately 5

minutes scolding the class. This lesson lasted for 30 minutes. The last ten minutes were spent on explanation of the 'substitution method' given by the teacher. She worked out some examples on the chalkboard and the learners copied answers in their exercise books.

Results of events in Classroom A

The interactions between the teacher and the learners and between the learners themselves in Classroom A revealed different types of classroom interactions as follows:

1. Class registering roll calls by the teacher.
2. Question and answer dialogue between the teacher and learners whereby the learners mostly gave chorus answers. In this case, negative utterances or affirmation answers in the form of 'yes' or 'no' answers were given.
3. The teacher giving instructions to the class. e.g., "take your handouts" or "come and do number 2 on the chalkboard."
4. The learners asking for clarification or asking the teacher to explain more.
5. The teacher reprimanding learners about homework matters or misbehaviour in the classroom.
6. The learners explaining their work (mostly done on the chalkboard).
7. The teachers asking follow-up questions, namely "positive five and negative three gives you what?"
8. The teacher asking learners to give explanations.
9. The learners discussing the exercise(s) among themselves.
10. The teacher giving feedback (on homework or classwork) to the class.

Events in Classroom B

This section deals with events in Classroom B. Table 4.3 indicates the frequency counts of the interactions between the teacher and the learners and between the learners themselves. Eight lessons were also observed in this classroom.

Table 4.3: Frequency counts of interactions in Classroom B

Interactions	Time lapse (in minutes)							Total no of interactions
	5 (40)	**10 (45)**	**15 (50)**	**20 (55)**	**25 (60)**	**30 (65)**	**35 (70)**	
Lesson 1	21	27	10	12	10	6*		86
Lesson 2	2	20	20	16	6*			64
Lesson 3	15	17	27	28	8	8	8	
(double period)	7	22	13	11	19	17	21*	221
Lesson 4	8	7	7	4	3	7	0	
(double period)	3	9	5	9	0*			62
Lesson 5	10	3	12	8	9	15	13*	70
Lesson 6	4	11	12	16	7	3	0*	53
Lesson 7	3	37	22	15	0	3	0*	80
Lesson 8	2	15	11	34	24	27	12*	125
Total number of classroom interactions								**761**

Note: The asterisk (*) shows the length of the lesson, e.g., Lesson 3 (double period) lasted 70 minutes and Lesson 4 lasted 60 minutes, but during the last 5 minutes nothing much happened.

Looking across Table 4.3 above, it can be noticed that the distribution of events in this classroom varies from time to time, with few events happening towards the end of most of the lessons. A summary of these events is given below.

Lesson 1: More classroom interactions took place during the first 10 minutes of this lesson. Twenty one classroom interactions were counted during the first 5 minutes followed by 27 interactions in the next 5 minutes. The lesson started with a discussion about 'conversion' of time units, for example, 'how to convert hours into minutes.' Wetu (a pseudo name) wrote some exercises on the chalkboard and worked through the solutions while the class gave chorus answers. The class copied down the solutions from the chalkboard. After 15 minutes, the teacher asked a learner to work out the solution on the chalkboard and he talked to the learners while solving the problem. A class activity was then given (consisting of 4 problems) and learners worked individually on the activity. Some of the learners volunteered to work out solutions on the chalkboard. The communication was mostly on assigning the activity and checking learners' progress, for example "Sir, I can do number *b*?" or "Why don't you use this formula she used?" Wetu spent the last 5 minutes of the lesson correcting learners' work on the chalkboard and at the same time discussing the solution with the class.

Lesson 2: This lesson was taught just before 13h00hrs, the same day as lesson one (lesson one took place in the morning). Wetu wrote several class activities on the chalkboard before the class arrived. He read through the exercises and worked out the first solution. He then asked volunteers to work out the next solutions on the chalkboard. The rest of the class worked on the

same exercise on their own. Some learners stood up and walked in front to ask something from the teacher (in connection with the exercise given) while the teacher marked the exercise books handed to him. Some learners started talking among themselves. All these events happened during the first 15 minutes of the lesson. The communication during the next 5 minutes (20th - 24th minute) was about teacher's clarification on the calculations done on the chalkboard. Sixteen classroom interactions were recorded during the 20th – 24th minute of the lesson (see Table 4.2). Throughout the last 5 minutes of the lesson, the teacher worked out one more solution and continued marking learners' work. Some learners worked on solving the problems on the chalkboard until the bell rang. Therefore very few interactions were recorded towards the end of this lesson.

Lesson 3: This was a double period lesson that lasted 70 minutes. Wetu started the lesson by going through the test items written the previous lesson. Some learners asked for clarification here and there while the teacher wrote solutions of the test on the chalkboard. An average of 22 classroom interactions took place during the first 20 minutes. The class was then given an exercise to do. Wetu spent a minute or two writing the exercise on the chalkboard and asked the class to work on the exercise given (in their exercise books). It took the class approximately 5 minutes for most learners to finish the exercise. The teacher asked one learner to show his work on the chalkboard and then later corrected the learner's work together with the class. Three learners were given a chance to show their work on the chalkboard. Then the bell rang to signal that the first part of the period was over. The class continued un-interrupted. The conversation that followed here involved questions (mostly from the teacher) that were thought-provoking,

namely: “If I may just ask you, why do you have to divide by 9.80?” or “Explain why you did it like this.” After 45 minutes, Wetu wrote another exercise on the chalkboard and asked a volunteer to work it out on the chalkboard. The learners who solved problems on the chalkboard were also asked (by the teacher) to explain their work. The teacher intervened during these discussions and provided correct feedback to the whole class. An average of 17 classroom interactions was counted during the second last 5 minutes of the lesson. The teacher spent the last 5 minutes sitting behind the bench in front and checking the learners’ work that was brought to him. A total of 221 classroom interactions were noted down.

Lesson 4: This lesson was also a double period lesson. It lasted 60 minutes (instead of 70 minutes). Wetu started the lesson by doing revision work on the previous lesson (lesson 3) and spent at least two minutes on this work. He continued the lesson by giving classwork in a form of dictating the exercise to the class. The communication during the first 10 minutes, therefore, was mostly about clarification of classwork and keeping the class quiet. The class spent 5 minutes or so working on the exercise. The learners worked, quietly, with minimum interaction between learner-learner and between teacher-learner. One boy stood up and walked in front to ask the teacher something. He talked softly with the teacher who gave the explanations on the chalkboard. During the 20th – 24th minute of the lesson, the learners continued working on the exercise given. A girl stood up and showed her work to the teacher. The teacher explained something to her. Learners started talking to one another. Some learners handed in their work one by one. The teacher marked the books and gave explanations for the exercises. Six learners stood in front of the class next to the teacher, waiting for their books to be marked. Two girls

sitting in front compared their work. Some learners started discussing the exercise among themselves in groups of 2-3. The bell rang, but the class continued because the lesson was a double period. A girl stood up and asked something (inaudible). The class became noisy because learners started talking to one another at the same time. Another noise came from outside because learners from the other class were changing classes. The boys at the back started talking about their own private matters. Wetu continued marking learners' work unhindered. All these events took 20 minutes.

During the 40th – 44th minute, the teacher asked if there was a learner willing to work out the first solution of the exercise on the chalkboard. Two more learners volunteered to do calculations on the board. Wetu checked learners' work on the chalkboard with some learners intervening for further clarification. The last five minutes were spent on giving information about the upcoming test. A total number of 62 incidents were counted compared to 221 events in lesson 3, which was also a double period.

Lesson 5: This lesson portrayed an average of 10 classroom interactions recorded in every 5 minutes except during the 10th – 14th minute of the lesson where only 3 events were recorded. The very first communication incidents (a total of 11) were not counted because they were not content related. These incidents involved greetings and some questions about the whereabouts of certain learners who were absent in the class.

The teacher spent 5 minutes reprimanding a boy about homework issues. The next 5 minutes were spent on writing some classwork (exercises) on the chalkboard. The learners were asked to copy down the exercises. During the 15th – 19th minute, the teacher worked out solutions to the

exercises given and the class intervened by asking him to *explain how he solved the problems*. As the lesson proceeded, the teacher asked some learners to work out solutions on the chalkboard. The last 10 minutes were spent on more classwork. The classroom portrayed more interactions between the teacher and the learners and between the learners themselves during this time. However, the learners worked individually on the exercises given (no group work exercise was given). A total number of 70 incidents were recorded in this lesson.

Lesson 6: This lesson contained few classroom interactions compared to the other 7 lessons that were observed in this classroom. In the first 5 minutes of the lesson, the teacher wrote a class activity on the chalkboard. The lesson dealt with 'conversion of units' (e.g., given 40 litres = 280 miles, how many litres are needed to cover 87 miles?). The learners talked among themselves and made noise. During the 15th – 19th minute, the teacher wrote more exercises on the chalkboard. He read through the exercises (some learners asked for clarification here and there). The class became noisy but kept quiet after some time. During the 25th – 29th minute, the teacher sat down and did some paper work. Most learners worked on the exercises given but others were just idle. In the last 10 minutes, the teacher asked learners to hand in their exercise books for marking. He continued marking the books until the bell rang. Therefore, only 3 classroom interactions were recorded during the last 10 minutes of this lesson.

Lesson 7: The teacher spent the first 5 minutes writing an exercise about 'inverse proportion' on the chalkboard. He read through the exercise and worked it out. The next 15 minutes were spent on question and answer conversation between the teacher and the learners and between the

learners themselves. The last 15 minutes were spent on classwork. While learners worked individually on the exercise, the teacher sat behind the front bench and read through his book, waiting for learners to submit their work for marking. Most girls finished the work first before the boys and handed in their exercise books. Some learners at the back of the class felt asleep and it looked as if the teacher did not notice them. Just before the bell rang more learners handed in their books for marking. Some announcements were given through the intercom by the Headmaster. The learners started talking among themselves and the class became noisy. The bell rang and the class was dispersed.

Lesson 8: This lesson recorded the highest number of classroom interactions (125 in total) in comparison with the other seven lessons that were observed. Except for two episodes that were recorded during the first 5 minutes, an average of 20 classroom interactions per 5 minutes was recorded throughout the lesson period. The topic of the lesson was 'Direct Variation' which dealt with straight line graphs (e.g., $y = mx + c$). Learners were given equations (e.g., $y = 2x$) and were asked to find coordinate values of x and y. At Grade 11 level one would expect this type of exercise to be very easy but it seemed that most learners in this class had a problem of conceptualising this exercise. The teacher spent the rest of the lesson explaining concepts such as the gradient, the y-intercept and the coefficients. The learners asked questions such as "what is a coefficient?" or "why?" or "what does it mean?" The teacher repeated most of the examples that he provided at the beginning of the lesson but still most learners did not grasp the explanations given.

Results of events in Classroom B

The interactions between the teacher and the learners and between the learners themselves in Classroom B revealed the following types of classroom interactions:

1. Question and answer dialogue between the teacher and the learners whereby the learners mostly gave chorus answers. In this case, negative utterances or affirmation answers in the form of 'yes' or 'no' answers were given.

2. The teacher giving instructions to the class e.g., "hand in your books for marking" or "come and do number 3 on the chalkboard."

3. The teacher giving explanation or clarification on class activities.

4. The teacher asking learners to do classwork or to explain their work e.g., "explain why you did it like this?"

5. The teacher giving feedback (on homework or classwork) to the class.

6. The teacher dictating the exercises.

7. The teacher reprimanding learners about homework matters.

8. The teacher reading through the exercises.

9. The learners asking for clarification or explanations, e.g., "Sir, why don't you use this formula she used?"

10. The learners discussing the exercise(s) among themselves.

Events in classroom C

This section deals with events in Classroom C. Table 4.4 below indicates the frequency counts of classroom interactions between the teacher and the learners and between the learners themselves. Six lessons were observed in this classroom.

Table 4.4: Frequency counts of interactions in Classroom C

Interactions	Time lapse (minutes)							Total no of interactions
	5	**10**	**15**	**20**	**25**	**30**	**35**	
Lesson 1	22	17	30	26	7	25	7*	134
Lesson 2	64	35	13	6	4	22	8*	152
Lesson 3	35	31	30	32	7	33	23*	191
Lesson 4	33	42	46	19	9	30*		179
Lesson 5	47	45	13*					105
Lesson 6	35	30	29	28	38	25	17*	202
Total number of classroom interactions								**963**

Note: The asterisk (*) shows the length of the lesson, e.g., Lesson 5 lasted 15 minutes only.

Table 4.4 above displays the highest number of classroom interactions (963 in total) compared to 590 and 761 interactions in Table 4.2 and 4.3, respectively. With the exception of Lesson Number 5 which lasted 15 minutes only (due to school activities that happened before this period started) this classroom portrayed more classroom interactions between the teacher and the learners and between the learners themselves than the other two classrooms A and B. Below is a summary of events in all 6 lessons as they were observed consecutively.

Lesson 1: The topic for this lesson was 'factorisation'. In the first 5 minutes of the lesson, the teacher started the lesson by writing two problems on the chalkboard, namely ab+2a+bc+2c and ap-aq-bq-bq. She worked out the solutions on the chalkboard and in the meantime asked learners what was the next step to be carried out during calculations. The teacher then spent the next 25 minutes explaining and calculating (using examples) how to factorise 'quadratic trinomials', e.g., $x^2 - 2x - 3$. Most questions that were asked by the teacher were leading questions (e.g., "what do I get when I add six plus negative four?"). Learners participated in the conversation by giving short brief answers (e.g. two, four, three etc.). The learners paid attention and copied down the examples from the chalkboard. The teacher spent the last 5 minutes explaining in detail how to factorise the 'difference of two squares'. The lesson ended with announcements given through the intercom from the Headmaster's office about afternoon school events.

Lesson 2: The topic for this lesson was 'graphs'. A total number of 64 classroom interactions were recorded during the first 5 minutes of this lesson. This was the highest number recorded so far in all 22 lessons that were observed in the three classrooms (A, B and C). The teacher started the lesson by going through the homework exercises. She read through the homework problems and learners said their answers in turns, row by row. The conversation did not involve deep meaning (in terms of conceptual understanding) from the learners' side. The teacher spent the next 10 minutes plotting points (coordinate points) on a Cartesian plane, namely points H (3,1); I (-1, 3) and J (-3, 0). She explained in detail how to plot coordinate points. She asked some learners to plot points on the chalkboard. Three girls stood up and plot the points. The rest of the class was asked to copy down the answers from the chalkboard. During the 20th – 24th minute,

the teacher wrote another exercise on the chalkboard about 'interpreting graphs' and asked learners to pay attention and to discuss with her what they knew about the term 'conversion.' The dialogue that took place towards the end of the lesson was very interesting because the teacher asked higher order questions (Bloom's taxonomy) that required learners to think about real-life experiences and to enable them to relate their existing knowledge to other familiar instances.

Lesson 3: This lesson was a continuation of the previous Lesson Number 2 (above) on graphs. From table 4.3 above, it can be noticed that an average of 30 classroom interactions was recorded for every 5 minutes interval except during the 25th – 29th and 30th – 34th minute where 7 and 23 episodes were recorded, respectively. The teacher spent the first 5 minutes reading the homework exercises and learners said their answers one by one (from row to row). In the following 5 minutes (10th -14th minute), the teacher asked some learners to plot points on the chalkboard. She then gave feedback to the class on the work done by the learners. The next 15 minutes (15th to 25th minutes) were spent on more class activities and teacher's explanations on using graph papers and how to choose the appropriate scale for the graph. The lesson ended with the teacher explaining how to read and interpret graph sections; that is, how to read points where the graph cuts through the y or x axes.

Lesson 4: This lesson lasted 30 minutes instead of 35 minutes. It was still about 'graphs'. An average number of 38 classroom interactions were recorded during the first 15 and the last 5 minutes of the lesson. The learners gave non-challenging responses to the teacher's questions.

For example, the teacher would pose a question like, "We said that the time units are divided into…every small unit indicates how many minutes?" The learners' response would be "two minutes." During the 20th – 24th minute, the learners were given a class activity. The teacher walked around the classroom and checked the learners' progress on the activity given. She took time to explain things to the learners that were facing difficulties in getting the correct answers. Other learners discussed the exercise among themselves. Hence, the conversation that took place towards the end of the lesson between the teacher and the learners and the learners themselves was rich with meaningful questions.

Lesson 5: This was the shortest lesson among all the 22 lessons that were observed. It lasted for 25 minutes instead of 35 minutes. The lesson started late because of school events that happened just before this period started. However, interestingly enough, the teacher managed to engage learners in a conversation that recorded a total number of 105 interactions.

Lesson 6: The topic of this lesson was 'Travel Graphs'. I considered this lesson as a consolidation of the previous 5 lessons presented above because the examples and exercises given could be related to real-life situations as well as to other subject areas. During the first 5 minutes, the teacher drew the graphs on the chalkboard and asked learners to interpret them. The next 10 minutes were spent on questions and explanations about the graphs. In the last 15 minutes, the teacher drew another graph (distance versus time) and asked the class to mention the units used in the graph. She read through the problem and asked learners to explain the curve of a distance-time graph. Nuusiku used real-life experiences in this lesson.

Results of events in Classroom C

The interactions between the teacher and the learner and between the learners themselves in Classroom C revealed different types of classroom interactions as follows:

1. Question and answer dialogue between the teacher and the learners whereby the learners mostly gave answers in turns, row by row. In this case, very brief answers in the form of 'one' or 'ten' were given.

2. The teacher asking follow up questions, e.g., "I got here p and q. Why do I say that?"

3. The teacher giving explanations on how to work out solutions.

4. The teacher asking learners to work out solutions on the chalkboard or in their exercise books (giving instructions).

5. The teacher asking learners to pay attention.

6. The teacher asking higher order questions (Bloom's taxonomy), e.g., "How did you get five as an answer?"

7. The teacher giving feedback on the work done.

8. The teacher asking the learners to explain their work.

9. The teacher reading through the homework exercises.

The teacher spent most of the time giving explanations during her teaching. The learners in this class did not ask a lot of questions apart from giving responses.

4.3.3 The types of questions asked

This section concentrates on the different types of questions that were asked either by the teacher or the learners. Using Bloom's taxonomy of questioning technique, I specifically selected questions at the higher-level of cognitive understanding and ignored the ones at lower-level, namely recall type of questions. For example, questions such as *why, how, explain, what if…,* were taken into consideration and appeared in *italic* texts for easy identification. The extracts below illustrate some of the questions that were asked in the three classrooms observed.

Extract from Classroom A: Lesson 1 (Algebra)

Teacher: We add like terms. This one and this one here. The last one that we are going to do for today is the division. What is the rule for division? It is almost same like for multiplication. 'Like terms and unlike terms can be divided'. Let's do one example together: - $10a^3$ b ÷ - 2a × (b to the power 4) = $5a^2 \div b^3$. Negative ÷ negative gives positive.

Girl 3: *Why is 5 …?*

Teacher: We says $a^3 = a \times a \times a \div a = a^2$

Girl 3: I don't understand now! *Why is b… the denominator?*

Teacher: Because is … how many b are there… are down as denominator? Clear?

Boys: Yes mam! (two boys responded at same time)

[Teacher Ndapwa, 06.06.2005]

Extract from Classroom B: Lesson 3 (Conversion)

Teacher: But if you just do it like this (84/9.80) the main point is to convert … Now why don't you just keep quiet please! If I may just also ask you, *why do you have to divide by 9.80?*

Boy 33: *Why?*

Teacher: *Why*, someone who is not doing Mathematics asks you, why are you dividing with 9.80, why not multiplying?

Class: (class laughed because someone said something funny)

Teacher: Because of what? *Doesn't know, explain why …*

[Teacher Wetu, 06. 07. 2005]

Extract from Classroom C: Lesson 1 (Factorization)

Teacher: I got there p plus q. *Why do I say that? … when the signs are all negative. What happens if I remove these brackets? (p + q)?* I've got minus b times p ne. *What will happen when* I multiply minus b times positive q? I will have minus bq. (T erases the positive sign in the expression i.e. a(p - q) – b(p - q)) *What will happen if* I multiply this minus b times minus q?

[Teacher Nuusiku, 19. 07. 2005]

Table 4.5: Summary of frequency counts of questions asked in the classrooms

Lessons (L)	**Classroom A** (Ndapwa)		**Classroom B** (Wetu)		**Classroom C** (Nuusiku)	
T= teacher L= learner	**T**	**L**	**T**	**L**	**T**	**L**
Lesson 1	7	4	2	6	6	0
Lesson 2	0	5	1	2	19	2
Lesson 3	1	2	6	14	4	0
Lesson 4	0	2	0	3	14	2
Lesson 5	2	0	3	0	5	0
Lesson 6	0	3	0	0	23	0
Lesson 7	0	4	0	9		
Lesson 8	2	1	2	11		
Total no. of frequency counts	12	21	14	45	71	4
Grand Total	33		59		75	

The statistical data in Table 4.5 above show the total frequency counts of the questions asked by the teacher and those asked by the learners. The pattern indicates that Classroom C has the highest number of questions (twice that shown in Cassroom A) irrespective of having two lessons short compared to the other two classrooms. Nuusiku dominated the discourse by asking questions (95%) that are supposed to elicit learners' thinking skills. Specifically, in Lessons 1, 3, 5 and 6 the learners did not pose a single question.

An interview session with Nuusiku, however, revealed that learners felt uncomfortable during the researcher's visits. Nevertheless, attempts were made to minimize observation effect by

trying to stay with the class much longer. This revelation is be considered as one of the limitations (or shortcomings) of this study. The extract below was taken from a transcribed audio-tape interview with Nuusiku:

Researcher: Your learners were quiet most of the time. Is this how they usually behave?

Nuusiku: *Yes*

Researcher: They didn't make much noise. I visited other schools where learners made noise and screamed and do things like that while the teacher is in the class. But I noticed that with your learners they were quiet and very obedient. I don't know if I can put it that way?

Nuusiku: Yes

Researcher: Is that the way they would normally react or …?

Nuusiku: No, is not the way. But they are not a difficult class at all. The last few days I struggled to keep them quiet, to get them to get their attention all the time but it is not very bad**.** It's the incidence from the time you were recording when you are not there anymore. And the other thing is, they told me "Miss we are a bit stressed, when is the lady finish recording?"

Researcher: Ok!

Nuusiku: So, that's actually one of the reasons why they were quiet.

Researcher: Wow, this is very interesting because in the other classes, the learners wanted to make noise and they wanted to be heard and get noticed.

I found it interesting that the learners in Classroom B asked meaningful questions (i.e., questions at the higher-level of cognitive understanding gave 76%). For example, the learners asked questions such as "how did you get 6.4?" or "what if ..., explain?" The learners in Classroom A were also active in terms of asking probing questions (e.g., why, how, explain) compared to the number of questions asked by their teacher. That is, in Classroom A, 64% of questions were

asked by the learners while 36% of questions were asked by Ndapwa. One could therefore assume that the learners in Classroom A and B were active in terms of asking high level questions that require cognitive understanding.

4.3.4 The types of class activities carried out

This category describes different types of class activities and actions the learners were involved in. It specifically concentrates on the work done in class either by the teacher or the learners. *Written work* on the chalkboard or in the exercise books; *hands-on* activities; and *practical* investigations are part of this theme. However, activities such as sweeping the classroom or cleaning the chalkboard are excluded from these descriptions. The first extract illustrates how the teacher in this classroom expects learners to work independently on the classwork given. The emphasis on these class activities are indicated with *italics* for easy identification.

Excerpt from Classroom A: Lesson 3 (Algebra)

Teacher: 2a, and 2 times 3 is 6! So if you …rule when you multiply a term that is inside then you have to multiply again with each one inside the brackets. On the note, *I quickly want you to do the first example there, quickly* $2a^2 (a + y – 2b)$.

Girl 2: Miss… **(**teacher walked to the front of the classroom and checked students' progress on the class activity**)**.

Teacher: Ok, can we get the answer?

Class: Yes.

Teacher: What is first the answer? $2a^2$ times *a* is equal to $2a^3$.

Class: Two *a* cube. [Teacher Ndapwa, 08. 06. 2005]

Excerpt from Classroom B: Lesson 4 (Conversion)

Teacher: And then *let me give you classwork now*.

Class: Ooh!

Teacher: … *come and do this* **…** (he starts writing on the board and then said). If I write on the chalkboard, it takes time. *Just take your pen then I read you from the book.*

Learner: (mumble something)

Teacher: Ya. Don't say 'sir', *just write what I say* (teacher dictated the exercise to the learners. Some learners have problems following the dictation).

Teacher: Quiet, the second one … (teacher dictated the second exercise).

Boy 1: Nine pounds or …

Teacher: Ok, quiet … (teacher continued dictating). The 3rd one … I'm still repeating, just keep on writing.

Boy 2: Nee man!

Teacher: Ok, just wait! Ok, those three questions. Question 2, question 3? (teacher repeated question 2 and 3). *Ok, three questions. Hurry up, when you are done just bring the books for marking***.**
[Teacher Wetu, 07. 07. 2005]

In the extract below, the teacher asked some learners to plot points (on the graph) on the chalkboard. A few learners volunteered to work out solutions without being asked by the teacher:

Excerpt from Classroom C: Lesson 3 (Graphs)

Teacher: O.K, because I don't know whether … so**,** *I'm going to ask you to come up with some problems … O.K, whom will I ask? Ya, come!* (teacher called a girl in the front row). O.K, John, number B? Come!

John: I don't have a paper, miss! (he is supposed to plot the points on a graph paper. Later, he stood up and went to the chalkboard to plot the point B (2; 2)).

Teacher: *You plot this* (teacher referred to the point B (2,2))

Teacher: No!

John: (John erased something)

Teacher: Is he correct?

Girl 3: Yes, miss.

Teacher: Yes … (a boy stood up from the back and plot point C (-4,-1) on the board).

Teacher: Is he correct?

Class: Yes. [Teacher Nuusiku, 12. 09. 2005]

In the section above, the data revealed that in most cases the teachers asked the learners to either work out solutions on the chalkboard or to write the solutions in their exercise books. On a few occasions, one teacher dictated the exercise to the learners and asked them to write it down. In some few lessons (e.g., Lessons 1 and 7 in Classroom A; lesson 8 in Classroom B and Lesson 5 in Classroom C) the teachers did not give classwork. However, they worked out solutions on the chalkboard and the learners copied down the solutions. Table 4.6 below provides a summary of the class activities carried out in the three classrooms.

Table 4.6: Summary of class activities

Lessons (L)	L1	L2	L3	L4	L5	L6	L7	L8
Classroom A		**	*	*	**	**		**
Classroom B	***	*	**	**	*	*	*	
Classroom C	*	*	**	**		*		

Key: * indicates class activities carried out

4.3.5 Reference to learners' previous experience

The Learner-Centred philosophy emphasises the use of learners' previous or background experience in teaching. Therefore, this category emerged from instances that showed references to learners' previous knowledge or experiences with regard to the topic(s) covered by the teacher. Instances of teachers making reference to the use of prior mathematical knowledge were also counted. The learners were expected to recall what they had learned in their previous grades in order to solve certain Mathematics problems. For example, teachers expected learners to recall Mathematics rules and equations they had learned from previous grades. However, in some cases the data do not explicitly show the use of learners' previous or background experience in teaching but teachers just referred to learners' previous knowledge from earlier grades as some of the following extracts illustrate.

Extract from Classroom A (Lesson 1): (Algebra)

Teacher: *As you already know from the previous grades* ne, algebra... It's about algebra, and the things that I gave you, is a summary of *the things you have learned in Grade 8 and 9.* I'm just going through it quickly so that you can refresh and then we are going to do some exercises to see if you can still remember, nee?....

Teacher: So, under the topic algebraic expression *there are some things that you have learned and that you must remember***.** Because you are going to write in Grade 12, you already know that *we must write the things you already learned from Grade 8* up to Grade 12.

[Teacher Ndapwa, 06.06.2005]

Excerpt from Classroom A (Lesson 4): (Factorization)

Teacher: Mmhh, people you see this one is about factorizing. That was one of the problems that you … the questions that you are having problems with in the examination, ne? *Factorizing is the thing that you learned in Grade 9.* When we did the revision for the exam question paper, what did you see … something you need to factorize? What should we do?

[Teacher Ndapwa, 06.06.2005]

The results above showed that the teachers made references to the learners' previous experiences. Two teachers (Ndapwa and Nuusiku) made more references than the other teacher, Wetu (see Table 4.7 below). The learners were either asked to recall work done in the previous grades or they were reminded to use prior basic Mathematics concepts in order to work out solutions. Table 4.7 below gives a summary of frequency counts of references to learners' experiences.

Table 4.7: Summary of references to learners' experiences

Lessons (L)	L1	L2	L3	L4	L5	L6	L7	L8
Classroom A	√√√√√√√√	√√	√√	√√√		√		
Classroom B	√√		√		√			√
Classroom C	√√√	√√√√√	√√	√√		√√		

Key: √ indicates previous experiences

4.3.6 Reference to real-life experience

This category concentrates on episodes that describe the teachers' reference to real-life experiences. For example, the teachers used examples that were familiar to the learners' out-of class experience or when they did Mathematical problems that related to the learners' daily experiences. Examples of these instances are given in *italics* text in the extracts below.

Extract from Classroom B (Lesson 3): (Conversion)

Below is an exercise that was written on the chalkboard by the teacher on the topic 'money'.

1 pound = N$9.80 at Bank Windhoek

(i) How much in N$ can 268 pounds give?

(ii) How much in N$ can 150 pounds give?

(iii) How much in pounds can (a) N$ 84 give; (b) N$ 2 500 give?

[Teacher Wetu, 06.07.2005]

In the next extract below from Classroom C the teacher explained the 'trinomial' by using the learners' basic knowledge of the word 'tri' and using an example from out-of-school experience:

Extract from Classroom C (Lesson 1): (Factorization)

Teacher: I'm sorry. (T writes the answer: (p + q) (a – b)). The next one is the quadratic trinomial. You know what a trinomial is? *The word tri means?*

Girl 4: Three

Teacher: *Three ne! Tricycle, when you were little you were driving tricycles. Those are bicycles with three wheels.* So tri mean three that expression that has three terms. Now if you look at my expression (meaning, the written phrases on the board), the ax + bx + c that I write there. There are three terms. The first term contains a square. The *a* is the …

[Teacher Nuusiku, 19.07.2005]

It is interesting to note that two teachers used examples (in almost all their lessons) that were familiar to the learners' out of class experiences. The teachers, in most cases, used real-life examples in their teaching (refer to the extracts above). However, interestingly the teacher in Classroom A did not use real-life examples at all in all the 8 lessons that were observed. She taught algebra topics that were abstract by their nature. Therefore, it was no surprise that her lessons did not include real-life examples. Table 4.8 below gives a summary of frequency counts of references to real-life experiences.

Table 4.8: Summary of references to real-life experiences

Lessons (L)	L1	L2	L3	L4	L5	L6	L7	L8
Classroom A	-	-	-	-	-	-	-	-
Classroom B	x	x	xxx	xx	xx	xx	Xx	-
Classroom C	x	xxxx	xx	xxx	xx	xxx		

Key: x indicates reference to real-life experiences - indicates no reference to real-life

4.3.7 Reference to other subject areas

This section presents few examples of cases where the teachers made references to other inter-disciplinary subject areas such as Physical Science, Biology, Geography or other science-related subjects.

Extract from Classroom C (Lesson 2): (Graphs)

Teacher: Is that conversion? Water to ice? Is that conversion?

Boy 34: (*inaudible*)

Teacher: Water to ice is not conversion ne! *I don't know Physical Science. But it is change of … it is a change, is not conversion.*

Boy 35: Meters to …

Teacher: Ya, meters to centimetres! What else?

[Teacher Nuusiku, 08.09.2005]

Excerpt from classroom C (Lesson 6): (Graphs)

Teacher: What happens at the place where two graphs meet?

Boy 8: Equal

Teacher: What is equal?

Boy 9: Equal is … to the number of …

Boy 10: Is given …

Teacher: OK, you are *practicing Economics and Accounting*, ne?

Boys: Yes! (*chorus*)

[Teacher Nuusiku, 15.09.2005]

An interesting finding was that only teacher Nuusiku in Classroom C happened to refer to other subject areas during her teaching (Lesson 2 and 6). The other two teachers did not attempt to make any reference to other subject areas. Table 4.9 below gives a summary of frequency counts of references to other subject areas.

Table 4.9: Summary of references to other subject areas

Lessons (L)	L1	L2	L3	L4	L5	L6	L7	L8
Classroom A	-	-	-	-	-	-	-	-
Classroom B	-	-	-	-	-	-	-	-
Classroom C	-	β	-	-	-	β		

Key: β indicates reference to other subject areas - indicates **no** reference to other subject areas

4.4 THE EXTENT OF CLASSROOM INTERACTIONS

This section discusses the summary of the results in Table 4.10 below in order to address the second research question of this study. The section describes the dimension of classroom interactions in the three classrooms. The descriptions of these events illustrate the extent to which different activities and incidents happened. The second research question was, "*To what extent are Learner-Centred practices present in Namibian Mathematics classrooms?*" In order to answer this research question, a summary of the frequency counts of different events that were described in the previous section 4.2 (above) is given in table the below.

Table 4.10: Summary of events in the classrooms

Lessons (L)	L1	L2	L3	L4	L5	L6	L7	L8
Classroom A	√ √ √ √√ √ √ √ √	** √√	*	* √√	** √√√	**	√	**
Classroom B	* * * x √√	* x	* * √ xxx	* * xx	* √ Xx	* xxx	* Xx	√
Classroom C	* x √√√	√ √ √ √√ xxxx * β	* * xx √√	* * √ √ xxx	Xx	* √ √ β xxxx		

Key: * indicates class activities; √ indicates previous experiences; β indicates other subject areas; x indicates real-life experiences

From the table above we can see that Classroom C displays a reasonable amount of classroom events across the six lessons compared to Classroom B and A, respectively. The table also shows

that the common practices among the three teachers are incidences of the teachers making references to the learners' previous experiences followed by the use of real-life examples. In most of the lessons that were observed, teachers made reference to the learners' previous knowledge or experiences. Sometimes they also reminded the learners to recall previous Mathematics concepts and equations in order to work out solutions to certain problems. All the three teachers carried out one or two class activities in most of their lessons. These class activities mostly involved the teachers working out solutions on the chalkboard and the learners copying down the answers; the learners working out solutions on the chalkboard and/or the learners doing written exercises in their notebooks. One could, therefore, speculate that the extent to which the three teachers (Ndapwa, Wetu and Nuusiku) attempt to practice learner-centred approaches in their teaching is minimal, taking into consideration various factors that hinder the implementation of Learner-Centred approaches in most Namibian schools.

The next chapter gives a full discussion of the dimension of learner-centred classroom practices in the three classrooms. The 'actual' perspectives of the nature of classroom practices used in the Mathematics classes are provided.

Chapter 5

DIMENSIONS OF CLASSROOM PRACTICES

5.1 INTRODUCTION

The previous chapter dealt with the presentation of the results for this study. This chapter describes and discusses the dimensions of classroom practices with regard to the *nature* of Learner-Centred (LC) classroom interactions or practices as well as the *extent* to which Learner-Centred practices are present in Namibian Mathematics classrooms. The description of the nature of LC classroom practice contextualises the definition given to the term 'nature' as explained in the next section.

5.2 DESCRIPTION OF THE NATURE OF LC CLASSROOMS

Using the descriptive characteristics of the nature of classroom practice in Table 4.1 (Chapter 4), a description of the 'actual' situation in the Mathematics classrooms is given in this chapter. Tables 5.1 – 5.3 describe the nature of the three Classrooms (A, B and C) in a form of case studies. The purpose of these descriptions is to explain the events as they happened in the three classrooms.

Table 5.1: Nature of classroom practice in Classroom A

Teacher (**Ndapwa**)	Qualifications: Experienced teacher with Basic Education Teacher Diploma. Strict with learners but friendly. Used expository approach in all 8 lessons. Interacted with learners through question-answer method and discussion on written exercises.
Learners	Asked probing questions and initiated most of the classroom discourse. Responded to teacher requests and invitations to participate. Carried out tasks given to them in their exercise books or on the chalkboard. Sought further information by initiating discussions and shared information with peers.
Classroom	There were 38 learners. Seating arrangement: desks faced each other and created space for teacher to move around. Large chalkboard used frequently by both teacher and learners. The teacher gave handouts to the learners for use in class and homework.

Ndapwa had taught at this school for more than four years but this was the first year she was teaching Mathematics at Grade 11 level. She taught Mathematics at Grade 8 to 10 for the past years. Ndapwa was friendly but strict with learners, especially about late arrival, incomplete homework and/or lack of participation in class. She mostly used the expository method in all eight lessons that were observed. That is, she first worked out some examples on the board, then gave the class an activity. Sometimes learners were requested to write and share their solutions (on the board) with the rest of the class. When asked during the interview session whether she used other teaching methods, she said:

> *I mostly used that method, showing them (learners) the examples or letting them follow the example then I try to not (sic) let them doing it themselves….I usually do that because Mathematics is about something you first have to explain to them.*

> *Learners at our school they (sic) are actually, if I tell them 'just go and discover that thing on your own' then they will sit and won't do anything. So may be I need to guide them first....* [Ndapwa, 27 June 2005]

The learners participated in the lessons in a variety of ways. Whole -class participation was observed more frequently than individual participation. The learners initiated higher-order questions. These questions were classified as "*why*, *explain*, *how*" types. Except for written exercises and homework, no hands-on activities were given. However, Ndapwa used selected exercises from a recommended textbook and gave handouts to learners. No group work was used and this is what she said about using group work:

> *The time I was using groups, some of them (learners) will just sit there and some of them will listen. But some of them will be there but they will not participate in the group. So they will just be there.* [Ndapwa, 27 June 2005]

Ndapwa's experience in the teaching profession could be speculated as one of the factors that motivate her to use expository method frequently rather than other teaching methods such as discussions, investigations or field trips. The learners' eagerness to probe and initiate questions gave an indication that they are eager to learn. Therefore, these factors indicate willingness of 'Capacity to Improve' the implementation of LCE in this Mathematics classroom.

Table 5.2 below describes the nature of classroom teaching practice in Classroom B that belongs to teacher Wetu.

Table 5.2: Nature of classroom practice in Classroom B

Teacher (Wetu)	Qualifications: Inexperienced young graduate, with no teacher qualifications. Strict with learners but friendly. Wetu had a sense of humour. Used expository approach in all 8 lessons. Interacted with learners through question-answer method and discussion on written exercises.
Learners	Asked probing questions and initiated most of the classroom discourse. Responded to teacher requests and invitations to participate. Carried out tasks given to them in their exercise books or on the chalkboard. Sought further information by initiating discussions and shared information with peers. Asked higher-order level questions than their teacher (three fold). Were more engaged in class activities than the learners in Classroom A and C respectively.
Classroom	There were 30 learners only. A Physical Science laboratory without working benches for learners except for the teacher. Seating arrangement: normal desks and chairs pushed in front and made the class look overcrowded. The teacher stayed behind the tall bench in front and sometimes disappeared behind the fume cardboard next to the chalkboard. Large chalkboard used frequently by both teacher and learners. The teacher gave handouts to the learners for use in class and homework.

Wetu was a young inexperienced graduate with no teaching qualifications. He had taught at this school for less than two months because the school had a shortage of Mathematics and Science teachers. Wetu had a sense of humour. He was friendly but strict with learners about incomplete homework. His teaching methods were routine. He used the expository method in all eight lessons that were observed. That is, he first worked out some examples on the board then gave the class an activity. Sometimes learners were requested to write and share their solutions (on the board).

The analysed transcripts (Chapter 4) show that learners in this classroom participated more in the lessons than other the learners in Classroom A and C, respectively. They dominated class

participation by asking higher order questions and by volunteering to work out solutions on the chalkboard. They also discussed the topics among themselves without the teacher's guide. Whole-class participation was more frequent than individual contribution. The learners gave chorus answers but asked individual questions. Therefore, the learners in Classroom B dominated the nature of classroom interaction. When asked during the interview session how he decided on what method to use, Wetu said:

> "*OK, so like when I go to class and then I have to present a topic. I feel that first of all, I explain the topic to the kids, to the learners and then I worked out certain examples for them and then later on let them do examples. After that then I give them homework. Sometimes I let the learners do the activity on the chalkboard and then after that I give them homework*." [Wetu, 21 July 2005]

It is of interest to note that Wetu (a young inexperience graduate) with no teaching qualifications also used expository methods most of the time like the other teacher Ndapwa. Wetu's learners participated more in the lessons compared to other learners in Classroom A and C as shown by the result findings. One could therefore assume that Wetu's confidence (being a graduate) in teaching could have probed his learners to dominate classroom discussions. Therefore, the likelihood of 'Capacity to Improve' the nature of classroom practices becomes evident in Wetu's classroom.

The next table below describes the nature of classroom teaching practice in Classroom C which belonged to Nuusiku.

Table 5.3: Nature of classroom practice in classroom C

Teacher (Nuusiku)	Qualifications: Experienced teacher with Higher Education Diploma in Mathematics. Strict with learners but friendly. Used expository approach in all 6 lessons. Interacted with learners more than the interactions shown by Wetu and Ndapwa. Used question-answer method and discussion on written exercises. Asked almost all the questions (95%) during teaching. Asked exciting questions and gave interesting examples by using real-life experiences.
Learners	Did not attempt to initiate discussion or to ask questions in 4 out of 6 lessons that were observed. Responded to teacher's requests and invitations to participate in class discussions. Carried out tasks given to them in their exercise books or on the chalkboard.
Classroom	There were 35 learners. Seating arrangement: Vertical rows neatly arranged and created enough space for the teacher to move around. Large chalkboard used frequently by both teacher and learners. The teacher gave handouts frequently to learners compared to teacher Ndapwa.

Nuusiku taught at this school for more than six years. She was also an Economics teacher. Nuusiku was friendly but strict with learners especially about late arrival, incomplete homework and lack of participation in class activities. Her teaching methods were routine. She used expository methods in all six lessons that were observed. That is, she first worked out some examples on the board then gave the class an activity. Sometimes the learners were requested to write and share their solutions (on the board).

It is an interesting finding that the nature of classroom practice in this class was more teacher-dominated than Classroom A because although Nuusiku tried to engage learners with thought-provoking questions such as *why* or *explain*, the learners in her class were less active in

participation compared to other learners in classroom A and B. Nuusiku asked almost all the questions (95%) during the lesson and her questions were of the higher-order level (Bloom taxonomy). Kyriacou (1997) differentiates between lower and higher order questions as follows:

> One important distinction in categorising question types is between those which require the recall and reporting of facts or information (lower order questions) and those which require some manipulation of information, such as reasoning about, evaluating or applying information (higher order questions). Whereas lower order questions tend to have answers that are clearly right or wrong, higher order questions tend to be judged in terms of general qualities related to the thinking involved (p.43).

When Nuusiku assessed homework, learners participated by responding one by one (row by row) until the whole class gave solutions to the homework. She frequently distributed well-prepared handouts to the learners. The handouts were used for class activities and homework. When asked during the interview session how and why she used handouts more often, she said:

> *"One of the reasons why I give handouts is because some of them (learners) don't have textbooks. Some of them are sharing but the textbooks are not enough. For example, when we did module 2 in my class of 35, only three students have module 2 because we are working with modules in Grade 11. In Grade 12 we are using textbooks ...Mathematics. Because this book is so expensive, we just couldn't afford to buy".* [Nuusiku, 07 October 2005]

The three classrooms portrayed a variety of classroom situations. Teacher Nuusiku being more experienced than Ndapwa interacted more with her learners compared to Ndapwa, but she dominated the classroom discourse. One could speculate that because of her familiarity with the lesson content, Nuusiku dominated the classroom discussions. However, the 'Capacity to Improve' classroom practices were hindered mostly by learners' shyness. The nature of each classroom was therefore, influenced by the characteristics of the three components (mentioned

above) namely, teacher, learners and classroom setting. The dimensions of classroom teaching practices are described in the next section.

5.3 THE EXTENT OF LC PRACTICES IN THE CLASSROOMS

The figure below gives a visual representation of the dimensions (extent) of Learner-Centred activities in the three Mathematics classrooms. The attributes that define the nature of classroom teaching practice (Section 5.1) were used to categorise the dimensions of the different situations in each classroom.

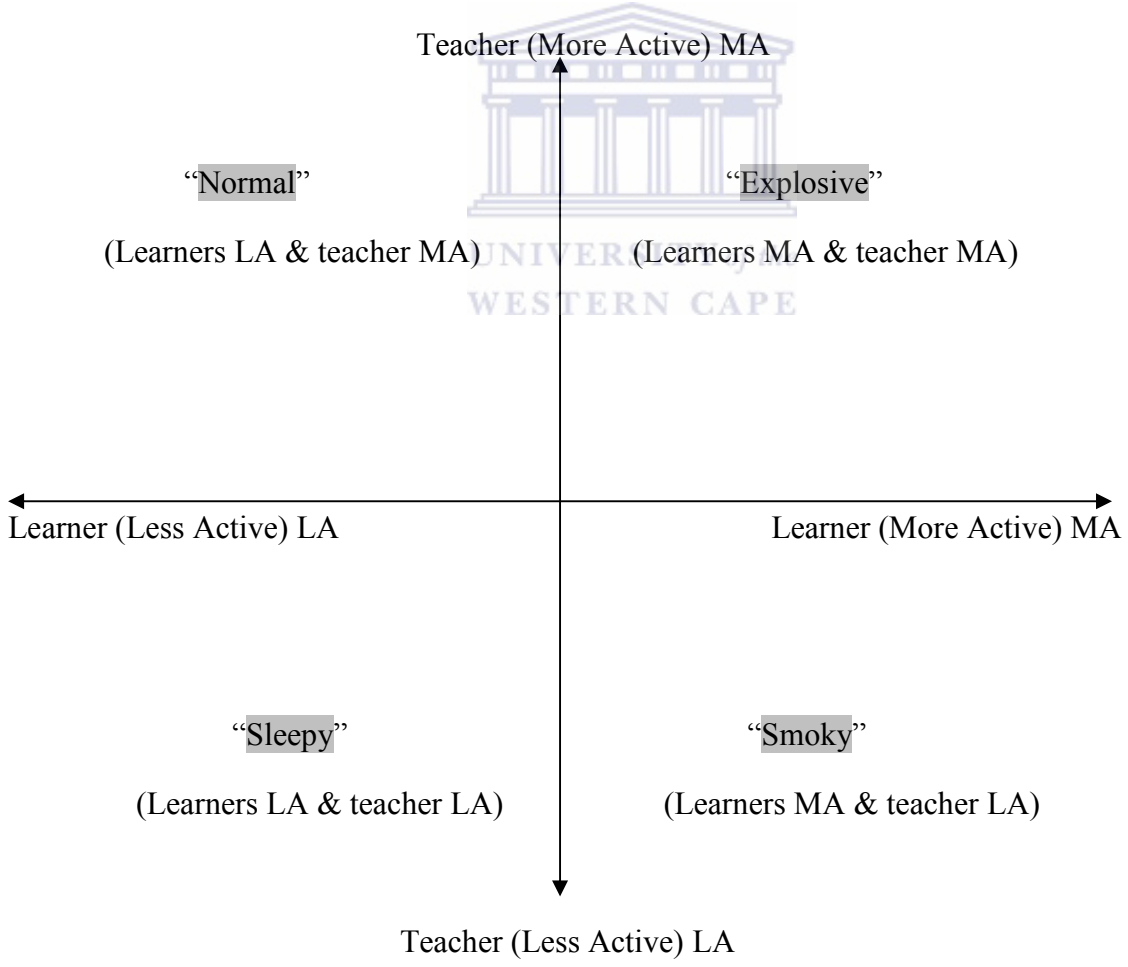


Figure 5.1 Classroom dimensions

The figure above gives a visual representation of the different classroom dimensions in terms of the nature of classroom teaching practice. The table below, therefore, provides a more concise description of the four categories as displayed by Figure 5.1 above.

Table 5.4: Description of classroom dimensions

Category 1 "Explosive"	**Category 2 "Smoky"**
Teacher-learner dominated environment. Learner-learner and teacher-learner interactions. Both the teacher and the learners are involved in question-answer and discussions. The teacher provides examples on the chalkboard and learners do class activities.	The learners dominate class discussions. The learners initiate discussion and control the learning situation. The learners facilitate the lessons; they take over control.
Category 3 "Sleepy"	**Category 4 "Normal"**
The learners lack participation in class activities. The teacher does not initiate discussion and does not take control of classroom events. The class is unexciting and dull; the class is 'sleeping'.	The teacher dominates class discussion with question-answer method. There is minimum learner-participation in class activities. There is minimum teacher-learner interaction.

Category 1 is called '*explosive*' because it represents an abnormal classroom situation. It symbolizes a dynamic, lively and vigorous classroom. Both the teacher and learners dominate the classroom environment by asking higher-order questions, doing written exercises and

initiating interesting discussions. The class is very alive; it is like waiting for something to explode.

Category 2 is named '*smoky*' because the situation in this category signals danger coming. Learners are more active than their teacher. They initiate discussions and take control of the situation. They are the facilitators of activities while the teacher is dormant. The whole situation is 'smoky'.

Category 3 represents a pathetic classroom environment. Everyone is '*sleeping*', the teacher as well as the learners. The teacher does not initiate any discussion and does not motivate learners into intellectual discourse.

Category 4 represents a classroom environment where the learners are less active while the teacher is taking control of the learning situation. There is minimum learner-learner participation in class activities. Teacher-learner interaction is also minimal. However, learning is assumed to take place because of teacher-dominated actions. Hence the category is called '*normal*'.

An overall picture of the *nature* and *extent* of classroom practice in the three classrooms A, B and C used in this study is given in Figure 5.2 below.

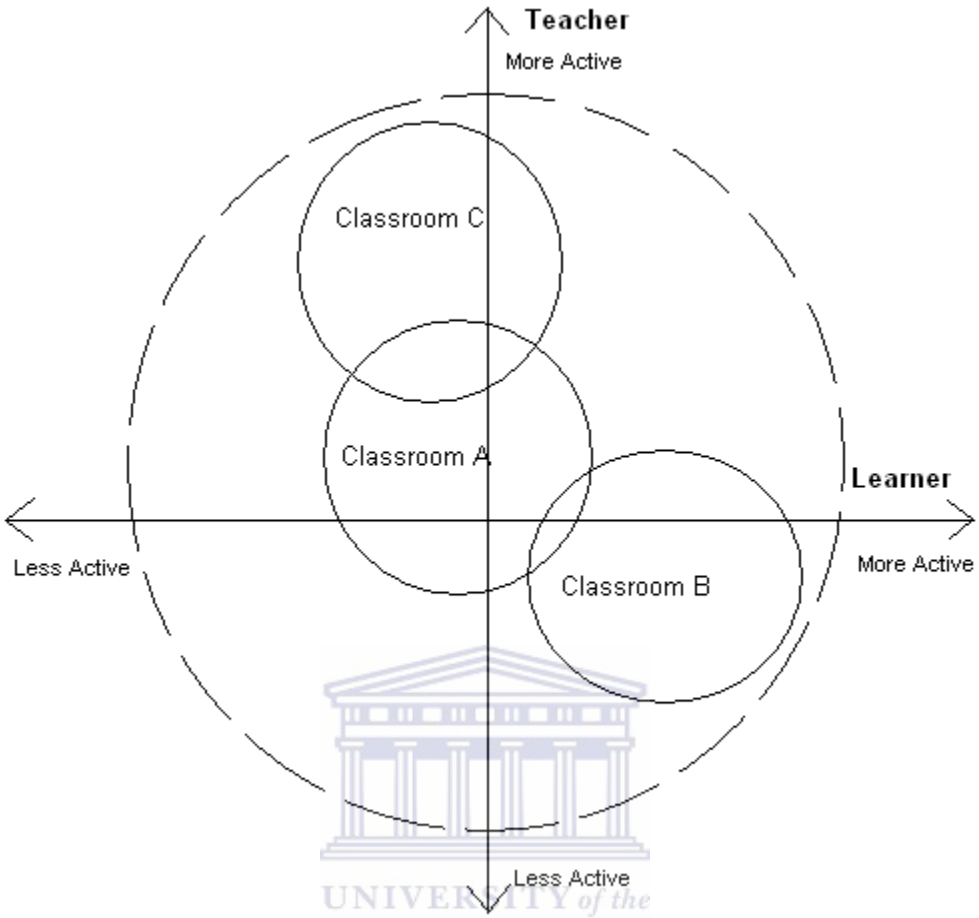


Figure 5.2 "Sand-Dune-Walk Model"

The title of Figure 5.2 is a metaphor used to represent a situation of a person (teacher or educator) walking in the sand dunes. An attempt to walk on the sand dunes in the Namib Desert is not easy but it can be fun. The wind can blow sand in your eyes and you may sink in the sand. This model can, therefore, be interpreted in terms of the movement or shift towards Learner-Centredness that teachers attempted during their lesson presentations.

Using the definition of Learner-Centred Education by MBESC (1996), I have summarised the following points (below) to describe a Learner-Centred classroom environment according to the Sand-Dune-Walk model:

- The learners are active because of their interest in the lessons.
- The learners are active because they are eager to learn and carry out challenging tasks.
- The learners are active because they ask higher-order questions.
- The learners are active because they are involved in classroom discussions and activities.
- The teachers are active because they facilitate and monitor classroom activities.
- The teachers are active because they engage learners in meaningful and challenging tasks that trigger high cognitive thinking.

By using the above characteristics, the shift towards Learner-Lentredness in the three classrooms is explained below.

Classroom A and C are teacher-dominated and use question-answer methods but learners in Classroom C were too reserved and quiet compared to learners in Classroom A. Learners in Classroom C showed little learner-learner interaction. Hence, the circle that represents classroom C is placed further up the axis of the teacher (MA) while the other circles are placed a little closer to the x-axis in order to indicate learner involvement in the lessons. Classroom B is more learner-dominated than classrooms A and C. The learners in Classroom B asked more higher-order questions than the questions asked by learners in Classrooms A and C. The first category 'explosive' (Fig. 5.1) presents a 'desired' Learner-Centred classroom environment where both the teacher and the learners are actively involved in the lessons. Hence, the three circles

(representing Classrooms A, B and C) portray a fairly reasonable shift towards learner-centredness.

The next chapter presents the conclusions and recommendations based on the empirical findings of this study. Some suggestions are proposed for teacher training programmes in higher education in Namibia, such as teacher training colleges and the Faculty of Education at the University of Namibia.

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

Learner-Centred Education (LCE) is a broad concept that includes a variety of attributes and characteristics. The two main perspectives, as described by McCombs and Whisler (1997) are, individual learners' experiences, perspectives, background, interest, needs, etc. as well as the learning environment (best knowledge and best teaching practices that are effective). The previous chapter discussed the nature and the extent of classroom teaching practices in three Mathematics classrooms at Secondary school level in Windhoek city. The findings revealed traces of Learner-Centred approaches. Therefore, the conclusions and recommendations given in this chapter are based on the empirical findings and discussion of the results given in the previous chapters.

6.2 CONCLUSIONS

The discussions on the nature and the extent of classroom teaching practices for a Learner-Centred Mathematics curriculum in Namibia revealed interesting findings. Therefore, based on the observed results given in the previous chapters, the following conclusions are made:

- From the discussions in the previous chapter, it can be concluded that the nature of each Mathematics classroom visited in this study influenced and affected (directly or indirectly) the teachers' classroom practices in the implementation of LCE. For example, fig. 5.2 (p. 121) depicts that the three Classrooms A, B and C are located at different levels in terms of teacher and learners' activities in the classrooms.

- The Mathematics teachers at the three senior secondary schools used the expository method more often in their teaching than other teaching methods such as lecturing, discussions and consolidation of fundamental skills. They are convinced that expository method is a good approach for teaching Mathematics. Specifically, the use of expository or exposition method has been noted to have a rich and rewarding classroom experiences, as described by DES (1985) below.

> Successful exposition may take many different forms... it challenges and provokes the pupils to think; it is creative to pupils' needs and so it exploits questioning techniques and discussions; it is used at different points in the process of learning and so, for example, it may take the form of pulling together a variety of activities in which the pupils have been engaged... (DES, 1985 *cited in* Simmons, 1993, p.3).

- The Mathematics teachers at senior secondary schools used the chalkboard very often, especially when assigning class activities. The learners were asked to work out solutions on the chalkboard or to write solutions in their exercise books. Two teachers used prepared handouts for the learners' exercises more than textbooks. The textbooks were mostly used as referrals for homework. For example, Classroom C was given more well-selected prepared handouts compared to other classrooms. Therefore, it is perhaps of no surprise that Classroom C portrayed a higher shift (see Fig. 5.2) than the other two classrooms.

> "*With the method that I used to set up my own notes, I use the textbook as a reference but I don't only use one textbook. I use more than one textbook*."
>
> [Nuusiku, 07 October 2005]

- The teachers attempted to implement Learner-Centred approaches in their teaching because the results indicated a shift towards Learner-Centredness. This kind of shift is described by Clarke (2002) when she notes that:

> Moving to a more learner-centred approach places greater demands on teacher knowledge, as the lesson can take many possible directions, given the more responsive nature of the teaching process, and students' strategies and reasoning could well change the teacher's mathematical ' comfort zone' (p.3).

- Using learner-centred approaches in Namibian classrooms is not easy because of the many challenges involved such as lack of resources, overcrowded classroom, and lack of discipline among the learners, just to mention but a few (Kapenda, 2007; Kasanda, Lubben, Campbell, Kapenda, Kandjeo-Marenga and Gaoseb, 2003; Shinyemba, 1999). Moreover, the Discussion Document (2003) on *Learner-Centred Education in the Namibian context* summarises some of the concerns on LCE as follows:

> When we move to the level of classroom practice, the picture becomes even more complicated. Research and monitoring done on teachers' and teacher educators' perceptions and practice of Learner-Centred Education reveal that although many teachers are familiar with the term, only a few of them have a deeper understanding of the concept and its implications. Classroom practice is beginning to change, but in most cases in a superficial way, mostly simply by the inclusion of group work as a method…however, where the concept of Learner-Centred Education is properly understood and put into practice, there is what Dewey called "substantial learning" going on (p.21).

Therefore, most teachers in Namibia are still struggling with the implementation of learner-centred approaches, as has been stated in the introductory chapter of this thesis. The results of the three classrooms discussed above present an attempt to use Learner-Centred approaches. Specifically, the Sand-Dune-Walk model reveals the complexity of Learner-Centred Education. The model shows that the teachers are at different levels of implementing LCE because the

willingness to show the 'Capacity to Improve' classroom practices is affected by different factors such as learner factors, teacher factors, physical resources and school culture. The teachers also view LCE not to be equal to group work. For example, none of the three teachers in this study used group work during their teaching, as their comments indicate:

> "*Group work? I just don't know. Maybe it's because I am not an outspoken person. I just love working on my own. Group work does not work for me.*"
>
> [Wetu, 21 July 2005]

> "*You know, the reason why I don't like them (learners) working in groups is that they don't always do what you tell them to do. So, I know that is one of the things that is...Learner-Centred Education, we mustn't do what we used to say, 'talk and talk'. We have to do Learner-Centred Education. But I find that is difficult for me because of the noise level as well as they don't always understand what to do. When they start talking to one another, they go, they don't stick to what they are supposed to do.*" [Nuusiku, 07 October 2005]

The initiatives shown by both the teachers and the learners are signs that classroom-teaching practices, especially in Mathematics lessons at Secondary schools, display some forms of Learner-Centredness. Teachers are trying their level best to implement Learner-Centred approaches in their teaching. The theoretical observations (informed by the data) indicate that there is an inter-link between the main constructs in this study, namely: policy formulation, capacity of the school system to take-up innovation or improvement and the power agents. This inter-link is shown by the teachers' willingness to adopt the policy using the physical resources that are available from the power agents. The recommendations given below can be used as a starting point on improving what teachers are already doing.

The recommendations given below can be used as a starting point on improving what the teachers are already doing.

6.3 RECOMMENDATIONS

By reflecting on the conclusions made above, the following recommendations are made:

- Mathematics teachers at Senior Secondary schools should endeavour to use a variety of teaching methods such as expository, discussion, demonstration (by using manipulatives that are locally available), just to mention a few. Using one type of teaching method, as has been observed in this study, has its own advantages because the teachers saw it useful. However, it is recommended that teachers should try to vary the teaching methods in order to enrich the lessons and to avoid the lessons becoming monotonous.

- Teachers should be encouraged to use a variety of teaching and learning media that stimulate learners' interest, especially nowadays with the introduction of Information, Communication and Technology (ICT) policy in Namibia.

- Learner-Centred Education is a complex teaching and learning approach. Therefore, the teachers need to be given full support from inside and outside the school boundaries in order to enhance their capacity to improve Learner-Centred Education in Namibia. Like Rogan and Aldous (2005, p. 317), the researcher therefore see 'Capacity to Improve' in this study, as an endeavour to elaborate on school-base factors that support or hinder the implementation of LCE in Mathematics classrooms.

6.4 SYSTEMIC SPECULATIONS

The recommendations below do not follow directly from the study, but they are necessary to mention because classroom implementation of any policy involves more than one stakeholder. Therefore, the researcher proposes these recommendations to the University of Namibia because it is responsible for the preparation of Secondary teachers in the country.

- The Faculty of Education at the University of Namibia (UNAM) which is responsible for pre-service teacher training at Senior Secondary level in Namibia, should encourage lecturers that are offering 'teaching methods' courses to use Learner-Centred approaches in their teaching so that the student-teachers will be able to emulate them.
- The Faculty of Education at UNAM should initiate feedback sessions for fourth year students on teaching practice experiences. Students will be required to note down challenges and difficulties they experienced during teaching practice Phase-II with regard to teaching methods that are more Learner-Centred and lesson presentations. An instrument can be developed to guide the type of feedback needed in these sessions. The information from the sessions could be used for research purposes and may provide empirical evidence for improving teacher training courses in the faculty.
- The Department of Mathematics and Science Education at UNAM should initiate a mentoring programme for Senior Secondary schools in Namibia. This programme should target Mathematics (and Science) graduate teachers in their first year of teaching. The mentors should assist inexperienced teachers with lesson planning, teaching strategies and innovation (improvising locally made teaching and learning resources).

6.5 IMPLICATIONS FOR TEACHER TRAINING

Currently Namibia, as a nation, has a long term vision called "Namibia Vision 2030". This vision aims at the production of citizens who are capable of making Namibia a knowledge-based economy. According to the Education and Training Sector Improvement Programme (ETSIP) document (2006, p.2), "The current education and training system is not able to rise to the call of Vision 2030…" Different stakeholders are involved in the implementation of this long term project. Pro-poor expansion of high quality senior secondary education, vocational education and training and training programmes have been identified as some of the critical priorities during the first phase of the ETSIP implementation programme.

So far, Namibia has four colleges that are responsible for lower and upper Primary and Junior Secondary teacher training through a three-year programme. The teachers are awarded a Basic Education Teacher Diploma (BETD). The University of Namibia is responsible for training Senior Secondary teachers through a four-year programme, Bachelor of Education (B. Ed). Criticism of the quality of teachers produced by the colleges and UNAM is widespread. ETSIP (2006, p.41) notes: "At present there are no clear guidelines on the content, quality or throughput by phase and subject and no umbrella body exists to provide such guidance to teacher education institutions."

The inception of Learner-Centred Education started with the BETD teacher training as mentioned in Chapter One of this study. Therefore, UNAM should strive to incorporate Learner-

Centred approaches as well because the document policy for Learner-Centred implementation applies to all teachers and teacher educators nationally.

The localisation of the International General Certificate for Secondary Education (IGCSE) syllabi is in line with the ETSIP mission. Moreover, ETSIP (2006, p.19) states: "Until recently, curricula were subject based not based on core competencies to be mastered by learners. This meant that unnecessary material was included and made teaching diffused." Therefore, it is hoped that the recommendations given in this study will be carried out in accordance with the ETSIP aims and objectives.

6.6 LIMITATIONS OF THE STUDY

First, this study utilized qualitative multiple case studies using a small sample. Therefore, the findings of this study can only be generalized to similar situations as those used in this study. Second, the use of one video camera instead of two or more posed another limitation to data collection procedures. However, I captured as much information as possible by being observant and vigilant during data collection sessions. Third, I used convenience sampling to select schools. As a part-time student, I collected data during my working hours. Therefore, it was imperative that the site of data collection was close to my work place. However, I was aware of the shortcomings of convenience sampling as stated by Cohen *et al*. (2000, p.103) that, "The researcher simply chooses the sample from those to whom she has easy access... and must take pains to report... that the parameters of generalizability in this type of sample are negligible." Since this study focused on three case studies in an urban environment, further research is recommended, specifically a comparative study between urban and rural secondary schools with

a bigger sample than the one used in this study. The results of the recommended study could be generalised and used to improve teaching and learning at a national level.

6.7 FURTHER RESEARCH

The research done is basically of the form of comparing teachers' ways of working with the theoretical and policy-driven characterisation of Learner-Centred Education (LCE). The research is thus of a compliance nature - to what extent does teachers' work comply with the theoretical and policy-driven characterisation of LCE? What is found empirically is that the teachers attempted to comply with the policy of LCE implementation. The current study cannot go far than through mere speculation about the teachers' attempt to use LCE practices. However, it is contemplated that the teachers attempted to conform to the policy of LCE implementation according to their own beliefs and perceptions on LCE. Therefore, further research is recommended on teachers' historical background, beliefs and perceptions on Learner-Centred Education in Namibia. Furthermore, an explanation on the motivations of the teachers at those points where they attempt LCE practices could form a promising question for further investigation, e.g. by a masters.

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APPENDIX A

Research instruments

No:……

[1]Teacher Interview Schedule For LCE Activities

(Semi-structures questions)

Observer: …… Date: ……..

School code: …… School name:……

Teacher Name: …… Teacher anonymous name: ……..

Gender (circle): Male or Female

Class (Grade level): …….. Number of learners: ……..

Duration: Start: …….. End: ……..

Lesson Topic: ……

Term (circle): 1 2 3 Year: ……..….

NOTE: Remember to ask for permission to tape record the interview.

INTRODUCTORY COMMENTS

Thank you so much for allowing me to sit in and observe your lessons.

I would like to follow up some things with you. It is never possible to understand all that is going on in a lesson just from watching it.

REMINDERS

1. You might need to answer teachers' requests about their lesson, so for example, you might need to say:
   - I enjoy watching you teach. I want to understand from you how and why you teach as you do. Your classroom is very different from the one I am used to. There is a lot I would like to talk to you about. (i.e. I AM NOT HERE TO JUDGE OR COMMENT ON THE QUALITY OF THE LESSON).

2. Also, you need to be sensitive to the possibility that the teacher might misread the question you are asking - see it as a criticism rather than an inquiry. Rephrase if necessary. You could also say:
   - In this interview, we may not always understand each other very well. If I ask anything that isn't clear or sounds strange, please tell me so that I can try to make it clearer.

SCHEDULE

1. LESSON PRESENTATION AND DEVELOPMENT

1.1 In this/these lessons you were dealing with (topic/s)……
Could you tell me briefly how you decide **what method** to use to teach this topic?

(In other words, what does teacher *draw on* to develop and plan lesson content and its delivery?)

1.2 Do you usually use more than one method in your teaching, why?
1.3 When you prepare to teach ……(topic), what difficulties do you think pupils might have? How do you prepare to deal with these?

2. USE OF RESOURCES FOR TEACHING AND LERANING

2.1 I noticed that you used ……(materials) in your lesson. (comment on resources and materials used or **lack of both** teacher & pupils).
How do you select what materials to use? Where do you get them from? What about pupils using materials? (i.e. probe use of material resources used in lesson)

2.2 In this/these lessons pupils mainly worked on ……..
(i.e. Comment on kinds of tasks set in the lesson)

How do you **select** and design the **exercises/tasks** you give the pupils? (i.e. Probe selection and construction on activities)

2.3 **Pupils also sit** on their own/ in pairs etc. ……..(i.e. Comment on the classroom organization) Do you specifically organize your class like this? **Why**? (i.e. Probe how and why classroom organization is at is)

3. MEDIATION OF KNOWLEDGE (methods/teaching approach)

3.1 I have seen how you teach a few lessons. I have also observed that you …….(if you can, describe the method of teaching you have observed). Is this how you usually teach? If not, what is different? How do you **usually teach**?
(Probe: the purpose here is to have from teacher what they think typifies their teaching)

3.2 I noticed in your lesson that you (describe how the teacher asks questions, give **explanations or examples** and gives feedback to students). Can you talk to me about:
- why you ask these kinds of questions
- why you give these kinds of explanations

3.3 I noticed in the lesson that (comment on pupil participation). Is this kind of **participation** usual in your lessons? How do pupils in your classroom usually participate in Mathematics lessons?
3.4 There is a great deal of talk today in education about **learner-centred approaches**, where pupils talk more in class to each other, ask more questions, and so on. What re **your views** on this?
3.5 What is your definition of the term "learner centred education" (LCE)?
3.6 During your teacher-training programme, were you taught about LCE approaches?
3.7 If so, do you think the training was **effective**? Can you explain more on your answer?
3.8 Do you think you **have been applying LCE** approaches in the lessons that I observed?
3.9 If so, how and why did you use LCE?

3.10How would you **rate your teaching** in terms of using LCE?

a. All the time b. Most of the time

c. Sometimes d. Never

3.11Could you **elaborate** on your choice, please?

3.12 Are you (have you) experiencing **problems** with implementation of LCE in your Mathematics classes? Can you explain more?

3.13 What do you think are the **most challenging factors** that hinder your implementation of LCE?

(Note: If possible, refer to specific cases you have observed).

3. 14 I noticed that you are using (or not using) **learners' background knowledge** or experience when you explain certain mathematical concepts? Why?

3. 15 While you are teaching, how do you judge/decide whether pupils are understanding?

3. 16 GENDER/DEALING WITH DIVERSITY

I noticed you have both boys and girls in the class and they interact easily/ only boys seems confident to ask questions etc *(what you notice)*. Is this usual? Can you talk to me briefly about the participation of girls / and then boys in you class?

---

[1] Adapted from: Adler, J., Lelliot, T. and Slonimsky, L. (1997) A Base-Line Study: Teaching/Learning Practices of Primary and Secondary Mathematics, Science and English Language Teachers Enrolled in the Wits FDE Programme.

Lesson Observation Schedule (LOS)

Indicators	Descriptions and examples of Indicators
A: (1) Learner-learner interaction	Interactions about mathematics ideas or topic(s) [not matters unrelated to mathematics lesson. E.g. "let's meet in the hall"]. *Examples*: (a) Asking for clarification ["what does the teacher meant by….?] (b) "Do you know how to solve this problem?" (c) Giving an explanation about mathematics topic(s). (d) Any other relevant interesting things (including non-verbal communications).
(2) Teacher-learner interaction	Interaction about mathematical ideas. E.g. (a) Giving or asking for an explanation/ clarification. (b) Content dialogue between teacher and student (s). (c) Any relevant discussion around mathematics topics.
(3) Learner initiated dialogue	E.g. (a) "What do you mean by….?" (b) "Can you please explain….?" (c) Content of the dialogue.
B: (1) Daily living reverences	E.g. "How do you balance your current account at the end of the month?
(2) Connections to other subject areas	E.g. "In Physical Science, you learned how to calculate the distance traveled using velocity equation.." **Note**: *These references could come from anybody in class (teacher or learners)*.
(3) Connections to prior mathematics knowledge	E.g. "Using algebraic equations (expressions), calculate the mean for the following…" **Note**: *Include things covered before or presumed already familiar to learners.*
(4) Reference to indigenous situations	E.g. "A woman in the village weaves beautiful baskets. What types of symmetries are portrayed by her designs?"

C: (1) Problem solving tasks (Polya)	None routine tasks, **not** just "*solve for x* " problems. E.g. "Given a right-angled triangle with sides labeled a, b, & c. How do you prove that $a^2 + b^2 = c^2$? Use diagrams or cardboards or any relevant materials to solve the problem.
(2) Problem posing (T & L)	Generation of problems by teacher or learner or both.
(3) Explanation by learners (why?)	E.g. Learners give their own explanations.
(4) Investigations (through making hypotheses, enquiry, experimental)	E.g. "Given circular objects of different sizes, strings, & rulers investigate why pie (22/7) is a constant.
(5) Extensions	Teacher or learners ask questions or elaborate on the work under discussion. Instances that are going on beyond the already established facts.
(6) Small Projects	Learners are given small projects to do or they report back on the project they did earlier on.

APPENDIX B

Research correspondes

UNIVERSITY OF NAMIBIA

Private Bag 13301, 340 Mandume Ndemufayo Avenue, Pioneerspark, Windhoek, Namibia

05 July 2004

To: Mrs. Claudia Tjikuua
The Director of Education
Ministry of Basic Education, Sport and Culture
Khomas Region
P/Bag 13236
Widhoek, Namibia

Dear Mrs. Tjikuua

Re: Permission to Conduct an Educational Pilot Study in Khomas Region

I am a Lecturer at the University of Namibia, Faculty of Education, Department of Mathematics, Science and Sport Education. Currently, I am studying (part-time) with the University of the Western Cape for my PhD. I am planning to carry out a pilot study in some of the Senior Secondary Schools in the Khomas region around July and August 2004 before I conduct the main study next year 2005 in the same region.

My research topic is: **"Translating policy into practice: An illumination of problems and challenges of implementing learner-centred classroom practices experienced by secondary school mathematics teachers in Namibian".** The study will involve all mathematics teachers at grade 11 and 12 in Khomas region.

The study attempts to determine the extent to which secondary school mathematics teachers *implement learner-centred approaches* in their classrooms as well as to establish the nature of *classroom challenges and problems* experienced by mathematics teachers in their teaching when applying learner-centred approach. It is therefore, anticipated that this study will expose relevant and necessary information that could be useful to both the Ministry of Basic Education, Sport and Culture and the University of Namibia in terms of best practices in teaching mathematics at secondary schools.

My supervisors are: Prof. Ole E. Torkildsen (Email: ole.torkildsen@hivolda.no)
Prof. Cyril Julie (Tel: 021-9592861 E-mail: cjulie@uwc.ac.za Fax: 021-9593358)

Could you kindly grant permission to conduct the pilot study as well as to carry out the main study next year 2005 in your region under the jurisdiction of your Ministry?

Yours sincerely

.....
Hileni Magano Kapenda

UNIVERSITY OF NAMIBIA

Private Bag 13301, 340 Mandume Ndemufayo Avenue, Pioneerspark, Windhoek, Namibia

08 July 2004

To: The Head Master

Dear Sir/Madam

Re: Permission to Conduct an Educational Pilot Study

I am a Lecturer at the University of Namibia, Faculty of Education, Department of Mathematics, Science and Sport Education. At present, I am studying (part-time) with the University of the Western Cape for my PhD. I am planning to carry out a ***pilot study*** at your famous school during these months July/Aug 2004 for a couple of weeks (2-3). I will be accompanied by a Research Assistant, Mr. Ricky Van Der Colf, who will use a video tape recorder in the classroom during our visits. I am also planning to use an audio-tape recorder for the interview sessions (if possible).

I intent to work with one of your experienced mathematics teacher at grade 11 (if possible) for this pilot project. My research topic is: *"Translating policy into practice: An illumination of problems and challenges of implementing learner-centred classroom practices experienced by secondary school mathematics teachers in Namibian"*. The main study (to be conducted next year 2005) will involve all mathematics teachers at grade 11 and 12 in Khomas region.

The study attempts to determine the extent to which secondary school mathematics teachers *implement learner-centred approaches* in their classrooms as well as to establish the nature of *classroom challenges and problems* experienced by mathematics teachers in their teaching when applying learner-centred approach. It is therefore, anticipated that this study will expose relevant and necessary information that could be useful to both the Ministry of Basic Education, Sport and Culture and the University of Namibia in terms of best practices in teaching mathematics at secondary schools.

My supervisors are: Prof. Ole E. Torkildsen (Email: ole.torkildsen@hivolda.no)
Prof. Cyril Julie (Tel: 021-9592861 E-mail: cjulie@uwc.ac.za Fax: 021-9593358)

Could you kindly grant us permission to conduct ***the pilot study*** at your school for a couple of weeks?

Yours sincerely

Hileni Magano Kapenda
University of Namibia
Tel: 206 3161 (w) 213613 (h)
Cell: 081 250 5510

REPUBLIC OF NAMIBIA

MINISTRY OF BASIC EDUCATION, SPORT AND CULTURE
KHOMAS REGION

Tel : (09 264 61) 293 9411
Fax : (09 264 61) 231367

Private Bag 13236
Windhoek

File No. 12/2/4/4/2

July 8, 2004

Ms Hileni Magano Kapenda
Faculty of Education
University of Namibia
Private Bag 13301
WINDHOEK

RE: REQUEST TO CONDUCT RESEARCH ON PILOT STUDY IN KHOMAS REGION

- Permission is hereby granted to Ms Hileni Magano Kapenda to carry out research on the topic mentioned above at
- Contact the principal of the school in order to put the necessary logistical arrangements in place.
- It should be noted that the normal school programme may not be interrupted and that those who will participate in the research should be doing so voluntarily.

We wish you best of luck in your endeavour and hope to be provided with a copy of final report upon completion of the project.

Yours faithfully

MINISTRY OF EDUCATION AND CULTURE
2004 -07- 09
P/BAG 13340
WINDHOEK
WINDHOEK REGION

09/07/04

MS C.U. TJIKUUA
DIRECTOR: KHOMAS REGION

cc. Inspector: Circuit 03

UNIVERSITY OF NAMIBIA

Private Bag 13301, 340 Mandume Ndemufayo Avenue, Pioneerspark, Windhoek, Namibia

26 April 2005

To: Mrs. Claudia Tjikuua
The Director of Education, Ministry of Education
Khomas Region
P/Bag 13236
Widhoek, Namibia

Dear Mrs. Tjikuua

Re: Permission to Conduct an Educational Research Study in Khomas Region

I am a Lecturer at the University of Namibia, Faculty of Education, Department of Mathematics, Science and Sport Education. Currently, I am studying (part-time) at the University of the Western Cape for my doctoral degree. I would like to collect data (information) for my study at the following Senior Secondary Schools:

My research topic is: **"Aspects of learner-centred classroom practices in mathematics in Namibian secondary schools".** The study will involve *at least three* mathematics teachers at grade 11 level from the schools listed above by using the following criteria (1) teacher's availability and willingness to work with the research team (2) a welcoming school environment that allows cooperation and willingness of school management and (3) a willing qualified mathematics teacher (with minimum teacher diploma and at least 3 years of teaching experience). The collection of data will take place as from **June 2005 up to June 2006.**

The study attempts to determine the nature of *classroom teaching practices* in mathematics classes. However, the study does **not** endeavor to determine whether teachers are right or wrong in their teaching. It is therefore, anticipated that this study will expose relevant and necessary information that could be useful to both the Ministry of Education and the University of Namibia in terms of best practices in teaching mathematics at senior secondary schools.
My supervisors are: Prof. Ole E. Torkildsen (Email: ole.torkildsen@hivolda.no) and Prof. Cyril Julie (Tel: 021-9592861 E-mail: cjulie@uwc.ac.za Fax: 021-9593358)

Could you kindly grant permission for conducting research in your region under the jurisdiction of your Ministry?

Yours sincerely

Mrs. Hileni Magano Kapenda
Tel. 206 3161 (w); 213613 (h) cell: 081 250 5510

UNIVERSITY OF NAMIBIA

Private Bag 13301, 340 Mandume Ndemufayo Avenue, Pioneerspark, Windhoek, Namibia

02 June 2005

To: The Head Master

Dear Sir/Madam

Re: Permission to Conduct an Educational Research Study

I am a lecturer at the University of Namibia, Faculty of Education, Department of Mathematics, Science and Sport Education. At present, I am studying (part-time) with the University of the Western Cape for my PhD. I am planning to carry out a research study at your school for a period of 2-3 weeks. I will be using a video camera during the class visits as well as an audio-tape recorder for the interview session (if possible).

I intent to work with one of your experienced mathematics teachers at grade 11 (if possible) for this project. My research topic is: *"Translating policy into practice :Aspects of learner-centered classroom practices in mathematics in Namibia secondary schools"*.

The study attempts to determine the extent to which secondary school mathematics teachers *implement learner-centred approaches* in their classrooms as well as to establish the nature of *classroom teaching practices* experienced by mathematics teachers when applying learner-centred approach. It is therefore, anticipated that this study will render relevant and necessary information that could be useful to both the Ministry of Education and the University of Namibia in terms of best practices in teaching mathematics at secondary schools.

My supervisors are: Prof. Ole E. Torkildsen (Email: ole.torkildsen@hivolda.no)
Prof. Cyril Julie (Tel: 021-9592861 E-mail: cjulie@uwc.ac.za Fax: 021-9593358)
Dr. David Mtetwa (Email: dmtetwa2002@yahoo.co.uk)

Could you kindly grant me permission to conduct the study at your school for a couple of weeks? Thanking you in advance.

Yours sincerely

.....

Hileni Magano Kapenda
University of Namibia
Tel: 206 3161 (w) 213613 (h)
Cell: 081 250 5510

APPENDIX C

Class tests and class activities

MATHEMATICS - CYCLE TEST GRADE 11 16 JUNE 2005

CLASSROOM A

1. MULTIPLY:

a) $-3p^2(2p^2-4p)$ [2]

b) $3x(x^2-2x+3)$ [3]

2. SIMPLIFY:

a) $2(x+3)+3(2x-1)$ [2]

b) $4(a-b)-(2a-5b)$ [2]

c) $3x^0 \times (3x)^0$ [2]

d) $\dfrac{2(ab^2)^3 \times (3a^2b)^2}{6a^5b^3}$ [3]

3. FACTORISE:

a) $4ab+6bc$ [2]

b) m^2-mp [2]

c) $7m^5-3m^4+8m^3$ [2]

4. SUBSTITUTE: If $a=-3$, $b=2$, $c=-1$, $d=0$, $e=1$

a) $2be-4ad$ [2]

b) $abcde$ [1]

5. SOLVE x:

a) $2x+4=4x+8$ [2]

b) $2(3x-6)=30$ [2]

c) $\frac{2x}{3}+\frac{3}{4}=4$ [3]

TIME: 40 MIN MARKS: [30]

CLASSROOM B ①

CANDIDATE NAME: _____

ANSWER ALL QUESTIONS ! TOTAL MARKS: 20

GRADE 11A. MATHEMATICS : TEST 1

1. The Length (L centimetres) of a rectangle is 70 cm, correct to the nearest 10 cm. The Width (W centimetres) of the rectangle is 15 cm, correct to the nearest centimetre. Complete the inequalities to show the limits of L and W.

Answer ..... $\leq L < W$ ..... [2]

..... $\leq W <$ ..... [2]

2. Given that \$1 = 1.547 ΔM, change 800 ΔM into dollars (\$), giving your answer correct to 2 decimal places.

Answer \$ ..... [3]

3. Maria buys a radio for \$50 and sells it for \$40. Calculate her percentage Loss.

Answer ..... [2]

4. A train completed a 672 km journey in 6.4 hours.

(a) Calculate the average speed of the train.

Answer (a) . . . . . km/h [3]

(b) Write 6.4 hours in hours and minutes.

Answer (b) . . . . . h . . . . . min [3]

(c) The departure time of the train was 22:40
What was the arrival time on the next day?

Answer (c) . . . . . [3]

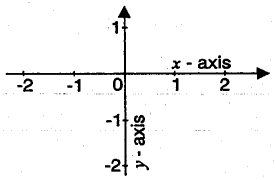
5. Write 21745.1984 into 4 significant figures.

Answer . . . . . [1]

TOTAL: 20

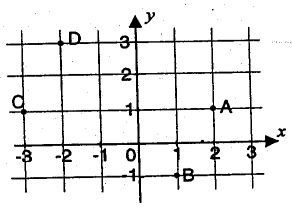
CLASSROOM C

8/09/05 Thurs



Examples

1.



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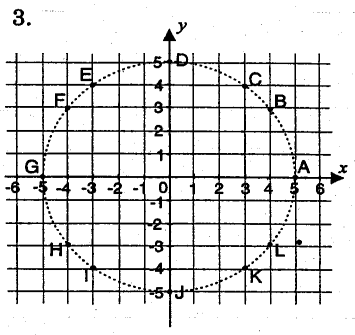

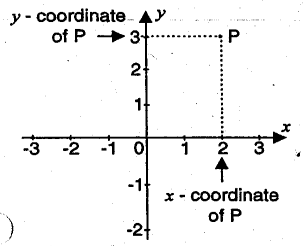

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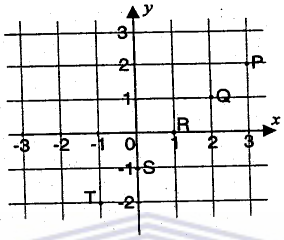

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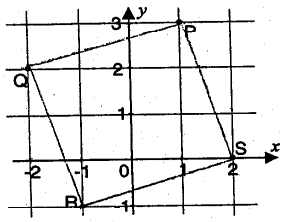

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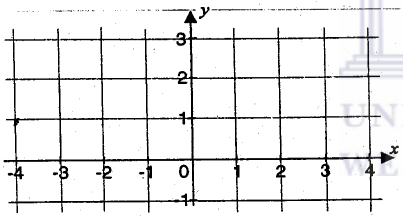

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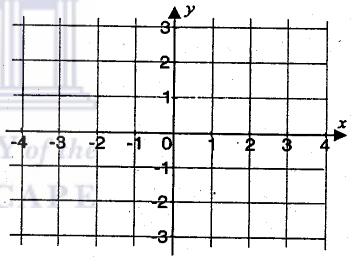
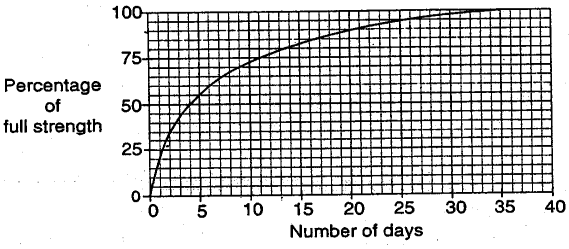
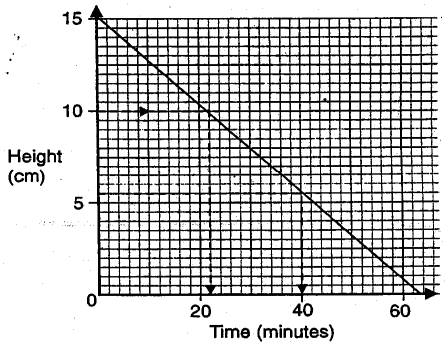






CLASSROOM C 18/07/05

E Simplifying of algebraic expressions (removing brackets)

1. Remove the brackets and simplify

a)	$3(y + 7) - 2(4y - 5)$	b)	$4(3s - 2t) - 3(s + 3t)$
c)	$-5(6z - 1) + 6(2z - 3)$	d)	$2(p + q) - (p - q)$
e)	$2(e + 3f) - 3e + 4(e - f)$	f)	$t(3t + 2) - (5t - 4) + 7$
g)	$4(y + 3) - 3(2y - 1)$	h)	$2(3x - 4t) - 5(s + 2t)$
i)	$-3(2z - 1) + 7(3z - 2)$	j)	$6(p + q) - (p - q)$
k)	$3(2e + f) - 4f + 5(e - f)$	l)	$t(2t + 1) - (4t - 3) - 5$

F Factorising algebraic expressions

1. Factorise the following expressions

a)	$18s + 12t + 24u$	b)	$9pq - 6qr$
c)	$20yz - 5z$	d)	$t^2 - 2t$
e)	$4y^2 - 6yz$	f)	$12p^2q - pq^2 + 15pq$
g)	$10s + 15t + 20u$	h)	$12pq - 9qr$
i)	$16yz - 4y$	j)	$t^2 + 5t$
k)	$9y^2 - 6yz$	l)	$6p^2q + 14pq^2 - 10pq$

G Simultaneous Equations

1. Solve the following simultaneous equations

a)	$b + 2c + 11$ $2b + c = 10$	b)	$x - 3y + 13$ $3x + 2y = 6$
c)	$3x + 2y = 12$ $5x - 3y = 1$	d)	$5u + 3y = 1$ $2u + 3y = -5$
e)	$4x = y + 7$ $3x + 4y + 9 = 0$	f)	$3x + 2y = 10$ $4x - y = 6$
g)	$p + 2q = 7$ $3q - 2q = -3$	h)	$2u + v = 7$ $3u - 2v = 7$
i)	$4s = 5t + 5$ $2s = 3t + 2$	j)	$6f - 6g = 5$ $3f - 4g = 1$
k)	$2x = 3y + 14$ $3x + 2y + 5 = 0$		

APPENDIX D

Responses to interviews

Interview No: 1 with Ndapwa

School A [H: Hileni & Nd: Ndapwa **]**

H: First of all, I want to thank you soo much for allowing me to sit in your class, ne and observe your lessons. So, as I have explained already ne…I just want to do a follow up on certain things. As you realized that at the beginning I told that… mmh I didn't want to interfere while you were teaching. So, this conversation for today is a follow up on the things which I found during the teaching… but because of the time frame so I have arranged this time so that we can… without interfering with your schedule.

Nd: Mmhh

H: I just want to tell you first that mmhh, please I m not here to judge your teaching, n. So, the questions I am going to ask is only that I want to understand better while you are teaching… and of course, during our conversation if I ask a question which is not clear, just feel free to tell me that "what do you mean by that?"

Nd: Ok.

H: Yes, then I can try to rephrase the question. Or if I ask something which sounds strange, you are free to… I am not sure about that, ya.

Nd: Ok.

H: Let me start with your lesson presentations. Now, in the lessons which I observed ne, you were dealing with topics such as algebraic expressions and equations, subject of the formula, about algebra topics ne? Now, is it possible to tell me briefly how did you decide on the method which you were going to use? For example, when the school starts ne, you know that you were going to teach algebra?

Nd: Mmhh.

H: Have you thought about the method which you were going to use? The teaching method? Have you thought about that?

Nd: Yes, I thought about it because that is actually the first time I'm teaching the Grade 11's.

H: Mmhh.

Nd: So, I'm thinking… so I noticed that when I started I went through the book and I saw that the explanations are coming from the book and that is the book the learners are using and the explanations… then I sit down and read through them… and then I make copies… I thought the other topics that we did… I give the learners notes…

H: Mmhh

Nd: …then I explained because the explanations are very clear, then I go through the notes with them. Then I realized that is much faster… if I have to write down the explanations on the blackboard then every time they still need to write things from the blackboard, so I decided I will give the notes… I just work through them..

H: Mmhh. So, you are referring to that Mathematics textbook…

Nd: Yes.

H: …which you show me the other day, ne? Ok!

Nd: Yes.

H: So, you… talk about using that other book…

Nd: Yes, because I've realized that when I used that book, we cover the topics faster... the previous topics because it is not … we cover.

H: Mmhhh

Nd: So, I make a whole set of notes for the specific topics… work faster…

H: Because I observed that you also did the examples on the chalkboard and then you asked the learners to do some of the activities. So, that is the way you thought … beforehand…

Nd: Ya

Nd: Mmhhh…

H: Or is that the …

H: Why do you think that is the best method?

H: Mmhh

H: Ya, because if I remembered correctly, I heard you a few times saying "please when I give you homework don't just go home and sit at home, go and work on the problems".

Nd: Mmhh, ya.

H: So, that could be the reason why…?

H: Ok. I also noticed that you did not use any other teaching aids. You know what I mean by teaching aids?

Nd: Yes, like transparencies?

H: Ya. In Mathematics it could be a lot of things. It could be other things learners could use … or it could be OHP. Is a lot of things anyway … that's what we mean by teaching aids.

Nd: Mmhh

H: So, I noticed that you mostly used the handouts. You said you copied them from that book, ne, right?

Nd: Mmhh

H: Now, how did you, how did you select the exercises that you gave to the learners. Was there any particular reason for you to … was there something guiding you to say that "I want to give this exercise and not that one", or did you just choose them at random?

Nd: No! I just look through because that mmhh … that booklet is giving some examples from the … like examination based questions …

H: Mmhh

Nd: So, I do those examples with them which is like examinations questions and then I discovered that there are some exercises that are in their books, but some of it I not in their books. So, I took it from the Grade 9 books, Grade 9 textbook.

H: Ok.

Nd: … that's why you saw I have wrote down some of the exercises on the blackboard and some of them…

H: Ok, now coming back to the issue of teaching aids, do you think there was a chance for you to have used any other teaching aids or do you think the topic you were dealing with was good for using the chalkboard or the handbook?

Nd: Mmhh…

H: Do you think there was a chance for you to have used any other… other teaching aids or you didn't just think about …?

Nd: Maybe I didn't just … but if you … maybe I can make some … to make … it clear … if there is time then I can make some posters to make it more clearer…

H: Do you think that a poster will explain things more better than …?

Nd: Maybe …

H: Ok.

Nd: Say for instance, there are some 'rules' then I can make a poster then just put it there. Then I will refer them to that poster.

H: Ok, rather than you putting them on the one side of the board. Good, I also noticed that in your classroom ne, you have these two rows, left and right…

Nd: Mmhh

H: Is there… why did you specifically decide to have your class organized that way?

Nd: (laugh) I didn't …I just thought that is more orderly. Because if they are sitting like… I usually let them sit in groups then I noticed if they stand up and go then everything look chaos. I think…it's more, it is better to control if…

H: …when there are two rows.

Nd: Ya, in the two rows. I can…last term I have them in groups, I have groups.

H: Ok, it's not that this is the way you always… for the whole year?

Nd: No! Last time I have the groups and … if I clean then I decide I want another way now.

H: Ok, I think that was very unique.

Nd: Is it?

H: Yes

Nd: Because most of the time pupils are just sitting in small groups…

H: Or they just in normal rows. So, I came and thought that this is unique.

Nd: …let them sit in rows

H: But, I think it was somehow orderly in a way as you said. Ya, I can agree with that. Now, I also observed that there was a time you asked your students to do class activity and then you went and sit at the back and then you start marking. Was there any specific reason for doing that, that day or was it just part of your routine?

H: Am I correct to say that the main reason was or you to finish marking so that…

Nd: Mmm (yes)

H: …they get their books to start revising for the test.

Nd: Mmm (yes)

Nd: Mmm

H: Why do…is there a reason for that particular…

Nd: Mmm (not clear) …not specific…

H: …you do it that that way…

Nd: It is just that sometimes…it's just happening. Because they are actually supposed to answer…

H: Ok.

Nd: …one particular at a time.

H: I know some teachers are very strict in their classes, they want learners to really respond when they are asked to say…"Ok, you say something".

Nd: Mmm

H: But I realized in your class you didn't mind. Which is still ok anyway. I think in a way it gives them freedom, or what do you say?

Nd: Ya

H: …to just respond when they feel like or what do you think?

Nd: I think it also in a way to give them freedom to get involved in the lesson.

H: Mmm

Nd: To involve them all in the lesson.

H: Ya, I know that most learners try to behave in a way because I was…I also picked it up sometimes and I also noticed…

Nd: Mmm

H: During these weeks in your class, is that the way they would normally behave or do you think they behave or do you think they behave in a certain way because of my presence there?

Nd: I think most of them are normally…is only that there are some few that try to be misbehaving or be something so that they can…But most of them…they behave like they normally behave.

H: Ok. I'm happy to hear that.

Nd: Mmm (yes)

H: Because you know that is better than…

Nd: Ya

H: Now, these days there is much talk about learner-centred approach…

Nd: Ya

H: …where people in this approach say "learners must do more activities" and so on and so on. Now, what are your views about this concept?

H: That's what I wanted to ask you that do you think that in the class I was observing the learners were really discovering something for themselves or you just wanted to… you have answered my question.

H: Ya. Now, how do you understand this concept learner-centred, if I ask you for a definition? How do you briefly explain the concept?

H: How do you understand that 'facilitation'? Can you explain a little more? Suppose I don't understand the word to facilitate?

Nd: (laugh) That is the only I can think of.

H: Good you know, that is Ok! Now, during your…you went through teacher training ne? Now, during your teacher training programme, were you taught about this learner-centred approach?

Nd: Ya (yes), we were taught about it.

H: Ok. Do you think the training was very effective about how to use LC approach? Can you explain…?

H: If I could ask, what kind of programme was that?

Nd: The programme that we did?

H: Yes

Nd: The BETD (Basic Education Teachers Diploma)

Nd: Ya. We didn't actually…we did the…when we did the teaching practice, we did have some lecturers who mentioned some points where we could involved learners. But, it was not actually where we have a workshop on that…

H: Ok.

Nd: …how to do it.

H: During your teaching the 3 weeks I have been with you, do you think that you have been applying LC approach?

Nd: Mmhh, I don't think I…I mostly taught them…

H: Normal

Nd: …the methods and…I just taught them the methods then left them to do some…for example, let them do the work

H: So, you think the way you were teaching you were not more learner-centred?

Nd: Yes

H: Ok. So, that means if I give you…

H: Ok

Nd: But, like certain topics like this one I was doing, I don't think…

H: …it was fit.

H: …or drawing something…

H: No, there are no right or wrong answers. And you are right. I also think from my personal point of view sometimes thee are just certain topics that are just good for LCE. Although depending how you understand LCE you can say that some topics need adjustment…to teach. Now, if I put a rating scale like:

H: Since that you are not a new teacher ne, in your experience as a Mathematics teacher, have you experienced some problems when you try to implement learner-centred approach? Do you think there are some problems which can arise when someone wants to use learner-centred approach?

Nd: (pause)

H: So, otherwise if I'm for example a headmaster and I said that every teacher in my school must use learner-centred approach. Would you not have any problem?

H: What about the teachers' side?

Nd: The teacher also. Because the teacher will have to go and do proper prepara…

H: Preparation

Nd: It seems they just forget about the things they learned in previous grades, Grade 8, Grade 9 because up to Grade 12 the things are just building (piling?) up. So, to me it seems that they just forget about the things they learned in previous grades because you even noticed that I have to give them those rules again.

Nd: So, they don't know what is a –ve times –ve gives a +ve. If they are finish with a year then everything is gone. I don't know if they…what is happening?

H: During your teaching, how do you tell that at this stage they are following or they are slowing down? What is that you get from them that makes you decide that "I think from here I must slow down or I must proceed…"?

H: Let's say, like that day when you were teaching 'substitution'…

Nd: If they ask…no, no you don't go too fast because to me it seems like…the things is like easy for me but then to them they cannot cope. Then I may be too faster, then they just…I don't know.

H: I also noticed that it seems that most boys they have little bit of confidence and more eager to ask question than girls. Is that because there were few girls in class or what is the problem perhaps?

Nd: I don't know really?

H: Is that the way they (boys) normally react or is it just that the boys wanted to get the attention of the camera?

H: But that is not the way they would normally ask questions, or what?

H: Ok. Today I noticed that the girl in front towards the left here ne, there at the front there…

Nd: Ya

H: That one there…

Nd: You see those ones there at the front are those…those ones are asking, they are the one who are much better than the others.

H: Thank you very much!

Interview No: 2 with Wetu

School B [H: Hileni & W: Wetu **]** 21 July 2005

H: Mr. Wetu, first of all I want to thank you very much for allowing me to sit in your class…

(*I stopped the tape and we change the site. First, we were sitting in his living room but then his family came with children and started talking. We went outside the house then I found out that it was also noisy due to traffic movement behind the wall. We later settled in the garage*).

H: I said, I wanted to thank you very much for allowing me to sit in your class.

W: Ok.

H: Yes, I enjoyed it very much.

W: Thank you.

H: Now, I just wanted to do a follow up on some of the things, because as you are aware when I was sitting in the classroom I told you that I was going to sit quietly because I didn't want to intervene with your teaching.

W: Yes

H: So, there were things which came up and I thought it is better if I ask afterwards in order not to disturb your teaching.

W: Ya, ya.

H: And then the whole purpose now, is just to ask from what I observed …

W: Ya, ya.

H: …it is a follow-up on that. Especially, how did you do some things and why did you do certain things.

W: Ok.

H: Now, in this interview, I really want you to feel free so that if I ask something which is not clear to you, just feel free to say …

W: …'that is not true'.

H: Yes, or … so that I can make it more clearer, yes. Now, I want to start with your lesson presentation, ne! Now, if I'm correct you were teaching measurements and ratios…

W: Ya

H: …and functions … graphs…

W: Ya

H: … you did on the last two days. Could you just tell me briefly, how do you … did you decide before hand what method you were going to use in your teaching? For example, the topic you'll be teaching. Ok, let me put it this way…

W: Mhmm (*I think Wetu did not understand my question. So I tried to rephrase the question*).

H: Do you have any idea about … when I talk about a teaching method?

W: Not really.

H: OK, with the teaching method I mean the strategy, for example if you are doing a preparation, ne..

W: Ya?

H: Example, tomorrow I'm going to teach this and this … Did you think of the 'how' you were going to present? The strategy like …

W: OK.

H: Are you going to use any way of … a special, not really special, but the way you present something. That's what I mean by …

W: Teaching method

H: Yes. Did you think of the way like, "I want to teach this way and not that way'. Did you think about that or …?

W: OK, so like when I go to class and then I have to present a topic. I feel that first of all, I explain the topic to the kids, to the learners and then I worked out certain examples for them and then later on let them do examples. After that then I give them homework.

H: But the method I'm referring to, ne is something you think before you go to class…

W: Before you go to class?

H: Ya. Do you think of a certain way that OK, "tomorrow this is how I want to do the presentation". Is a way of presenting

W: OK…

H: A certain way of presenting…

W: Ya, somehow but the problem is kind of like I didn't do a Bachelor of Education. That's why I lack some skills …

H: Not necessarily. You could still think of … I mean as reflection of … like "in this topic, I want to present it this way and not that way". That's all what we mean by teaching method in education.

W: OK

H: Ya, sometimes I know that if you really didn't go through it (*teacher-training*), it could be very difficult but it was really … because you didn't go through it, it does not mean that you don't think like that (*about teaching methods*).

W: Yes

H: OK then. Now, as you were saying, you usually think of an activity, I mean you …mmmh, you present an example and …

W: Ya

H: Is there any other way you sometimes present this, although I was thinking for a while, I don't think … I just have a feeling that is that the normal way you usually teach? Like giving examples in the Mathematics class and then you let the learners do activities?

W: Ya. I let the learners do it (the activity) on the chalkboard and then after that I give them homework. Ya, that's my normal procedure.

H: Ya, if you think that kind of …

W: Kind of …

H: That kind of teaching was good for you …

W: I realized that it would be much better for them (learners) to listen how a certain topic is being taught or is … the meaning of a certain topic and then later on I try to show them how to work out certain examples from that and then before I give them homework, I have to make sure that they understood by calling them to come to the chalkboard to do it and then later on I can give them homework apart from the classwork.

H: OK, thank you. Something else, that last day when I was sitting in your class you presented the graphs up to the end, like introducing them to the y-functions. Have you foreseen any difficulties when you were preparing or did it came as a shock when lots of learners in the class went like "we don't understand"! …

W: Ya, ya. I thought they have covered that during Grade 10 or Grade 9. As I said, I saw a certain … Grade 9 textbook. That's why it was a surprise for me to hear from them that they really don't have any idea what that expression (y= mx + c) means.

H: So, you were also surprised that…

W: Ya, but …

H: …that kind of reaction came up, because you thought it was going to be …

W: Ya, that's why I just did it and then I didn't first explain … because I assumed that they know that …

H: Unfortunately I couldn't come to the next lessons to see how you handle them (learners). So, but perhaps you can just brief me on what did you do next?

W: OK, the next day, that was day 7, I have to repeat everything that I taught in the Grade 6. Things like y = mx + c is the general equation for the straight line …

H: Mhmm (yes)

W: … and that's where we have to calculate the gradient and the y-intercept.

H: OK, I also noticed that most of the time you used the chalkboard and you didn't seem to use any other teaching aids or media as we call them. Like using OHP or handouts or using manipulatives. Manipulatives are usually things that you can give to learners for them to work with or to work on.

W: OK.

H: Is there any specific reason why you prefer just to …

W: To use the chalkboard?

H: Yes, to use the chalkboard.

W: The chalkboard … I have … ideas that … the concept of the kids because they are all looking at you and you are … on the board. But if you give them handouts some of them will just … because they are very talkative. But working on the chalkboard is much better than giving them handouts.

H: OK. I also noticed that during … because you like giving activities. In these class activities your learners were mostly working on their own …

W: Yes

H: You for example, I didn't see any group work or pair work. Is there a specific reason why you prefer just to give them like 'work on this' without saying 'try to work with a friend or … something …

W: …group work…

H: Any reason why you were doing it?

W: Is only that maybe it's because myself as well don't like working in groups. That's maybe …

H: No, that's fine.

W: That's why I just thought it's better if they do it on their own, individual. Sometimes if they have a problem I come …

H: What is the reason why you don't like group work?

W: Group work? I just don't know. Maybe it's because I am not an outspoken person. I just love working on my own.

H: But, isn't it when the learners are working in groups you give them a chance to communicate with their friends (peers)…?

W: Friends?

H: Yes, because you could say either 'two by two, you work together or three' because we normally recommend that if you are giving group work the group must not be bigger than 5 or so. Usually 2 to 3 or 4 is enough but as you were saying you feel that group work …

W: Group work does not work for me.

H: No, I was just asking. Now, those exercises you were giving to the learners, how did you select the exercises?

W: OK, when I'm preparing that lesson and then I tried to work out some (exercises) and then from that textbook that I was using, … that's where I have to pick the activities that they are going to do in the class.

H: But there was no specific thing to say that … was there a certain way in which you pick up certain exercises or you just work some and the rest you decide…?

W: Oh ya. It's like I work some (exercises) and then I give them (learners) certain sums that they have to work out …

H: Is there a certain way how you pick the exercises because I know in the textbook there is a lot (of exercises). How do you decide that is the one …

W: Ya, ya. It's like when I give them a certain exercise, I give them a certain example that I have worked on the chalkboard, I give them an activity to do that is similar to what I have worked out. And then later, I select something that I didn't … so that they can apply what I taught them to something else.

H: OK, now as I was saying, I realized that your students were just sitting in a normal classroom rows facing the chalkboard and you didn't seem to use any group work or pair work. But I think you have explained that. So, you never tried in that class or in any other classes to use pair work or group work?

W: No

H: … since you start teaching?

W: Because I just start teaching on the 1st of June (2005).

H: Oh, you just start teaching recently?

W: Perhaps I was still trying to know …

H: Do you think in the future you want to try it (group work)?

W: Ya, ya. I'll also want to give it a try, so that I can see if it works.

H: OK, that will be nice too.

W: Ya

H: To try it out, I think. Now, as I was saying, you like working out few examples first on the chalkboard and then you'll say "this is you class activity". So, that's the way you just teach or will you sometimes teach in a different way? For example, in that Mathematics class … is that your normal way of teaching?

W: Yes. But, sometimes is like … Ok, sometimes I give classwork, sometimes I give homework. I only give homework if what we have done in class they couldn't do it by themselves.

H: No, I was referring to your teaching …

W: Teaching? Ya, it is my normal way of teaching.

H: And you say the reason you like it was what?

W: Why I like it?

H: Yes, working out few examples and then giving class activities.

W: Ya, I have to give them ideas to understand how a certain topic is … and then later on they could try to use what I taught them to … to apply it to something else.

H: So, you never thought of teaching in a different way apart from …?

W: No, no.

H: Ok, thank you. I think there was also a time you asked a very good question. Where I cannot remember exactly but I think you said something and then you asked a learner "why did you like that? Can you explain …?" Why do you think that in teaching the way we ask learners to explain, that kind of probing is very important?

W: Ok, it is very important in the sense that we can detect whether the learners understand what we taught them. Because in Mathematics sometimes we have a lot of formulas and the learners will just substitute values in the certain formulas without understanding how…

H: And then … without understanding of the concepts?

W: Ya

H: I also noticed that during these class activities you liked calling your learners after they finish (with classwork) to come one by one in front for you to mark (the exercise) when they finish. Why did you decide to do the marking during the class teaching time and not after wards?

W: I like, I like that whenever I teach something I have to make sure that these kids understand before I proceed to something else. Because if I try to give them homework then that it will mean that, that certain topic is closed. Next time we have to move on. Therefore, I'd like to give them classwork to prove to me that they have understand (sic)…

H: And then you want to mark it here …

W: And then I want to mark and see for myself because sometimes I try to give them to mark their books but I realized that it's not a good idea because some of them just keep on cheating …

H: Ya, ya I know that.

W: Yes, but …

H: Now, my other question is, are you really sure that you mark every book?

W: Every book? Ya.

H: Because I noticed that sometimes you did not finish marking.

W: Ya, if I don't finish them those that they have books I haven't marked should leave their books (behind)…

H: So they (learners) leave their book behind? OK, good. I also noticed that there was a learner with special need, the boy in a wheelchair.

W: Ok.

H: And then I didn't …if I missed it, you can correct me if I'm wrong. Do you think every time when other learners were bringing their books did anyone pick up his book?

W: Ya (yes) and in that class I have also told them … they are very cooperative. That is good for them because every time that I marked them (books) one of the students have to bring the book of that girl and then …

H: Boy!

W: And then everyday since you noticed that my classes are on the 1st floor everyday they …

H: Ya, the picking up, I have seen them doing that. Is only during those class activities I was wondering when do they pick up this boy's work?

W: It is always on my desk …

H: Oh, ok good. Let's move to something else. These days there is much talk about learner-centred approach. Is that concept new to you or have you heard about before?

W: Ya, I have heard about it but I don't really know it. I don't know whether what I think that means, is what it really means.

H: And what are you thinking and what are your views about that concept learner-centred?

W: Ya, I think it, it is the exchange of ideas between the teacher and the learners. That, when you are teaching you should allow eye contact with the learners and try to give them time to ask you questions if they don't understand.

H: So, if I ask you to **give a definition of Learner-Centred Education in short**, what would be your definition?

W: Ok, that is … it is the … the concept that the teacher and the learners …

H: … the conversation.

W: …or the … how can I say this now? It is the participation of the learners in the class over the students' …

H: What type of participation?

W: Ok, something like more learners willing to ask questions rather than being shy and then just call them without getting …

H: Ok, so you explain that you didn't go through any teacher-training (programme) ne…?

W: Mmm (yes)

H: …during your study? So, seeing that somehow have an idea about Learner-Centred Education, do you think that you have been using the concept (LCE) when you start teaching?

W: Ya (yes), I think I have been using it because that is what happens in my class because we are always talking about that, always participation is between the learners and the teacher. I think I have used it in one way or another.

H: But I think sometimes those learners were just making noise talking about other things. Do you want to tell me that is also LCE?

W: Ok, … the things get out of hand. Ya, it happens sometimes and then I get frustrated sometimes when I'm teaching and they just talk about something else.

H: Ya, so now if I give you a rating of 4 like, in terms of using LCE, do you rate yourself using LCE;

- All the time
- Most of the time
- Sometimes or
- Never

W: I think 'most of the time'.

H: Most of the time, Ok. Could you elaborate on that kind of choice?

W: For 'most of the time'?

H: Yes

W: Yes because every time I teach I don't really take everything in my own hands. I try to like…let the ball be in into their own hands. That's what I always using …

H: The ball into the learners' hands?

W: Yes. It's like, I do something and then I let the talking be in the learners' hands. Like them (tackle?) what the problems are in that topic.

H: You mean for example the way you are giving them now and then activities …?

W: Yes

H: …the activities to do? So you think that's part of them being engaged…

W: Ya (yes)

H: …in what you are doing?

W: Ya

H: You don't think there is any problem at all with the implementation of LCE in your Mathematics class?

W: No, but I think there are still some problems …

H: Which are?

W: Like, just what you have said now that sometimes when I am teaching there some (learners) who are talking something else. That is like giving them too much freedom. But then I have to come in sometime to be a little aggressive so that they can stop …

H: OK. So, if I could ask you, what will be the most challenging factors which for example, I want you to implement LCE all the time, what could be the most challenging …?

W: (pause)

H: You said ne, you feel that you used it (LCE) most of the time. Not really every time …

W: Ya, ya.

H: …but in most cases. But now suppose I said I want you to implement LCE every time, what would be the most challenging things which could be … factors?

W: Most challenging things?

H: Factors that could hinder your implementation of this approach, every time?

W: OK, maybe that could be now coming in the sense that if you really have to give them (learners) more time to work among others, maybe that would mean then like giving them group work. Then later on let them present what they have discovered in their group work. And then maybe that's where I have to work on, if you mean every time.

H: No, no, no! Don't get me wrong. I'm not saying 'you have to'. I was just trying to …

W: Ya

H: OK. I noticed also that you seem not to have used in a few instances but sometimes when we talk about Learner-Centred Education, the philosophy is based on using learners' background experience as opposed to teacher-centeredness. Do you think you have been doing that kind of thing? In the topics you have been teaching?

W: Ya, I think so but not that much. It's only that every time I introduce a topic I try to ask them what they understand … they try to tell me what it is. And if I still have some doubts then I give them … description that … but if there are no problems than we can just go on …

H: Now, in this concept when now we talk about learners' previous knowledge, what is your understanding on that? How do you … using learners' background knowledge?

W: I think …?

H: Let's go back to this topic of 'graphs'.

W: Graphs?

H: Yes, supposed you were going to teach graphs … how would you use learners' background knowledge to introduce that topic? What … in your introduction?

W: Ok, … the equation of the straight line …then they try to explain to me what exactly is the equation of the straight line and they try to do the gradients and the y-intercepts. They will show me how to draw a straight line graph.

H: During your teaching ne, … during the teaching itself, how do you decide that 'at this point the learners are getting what I'm doing or they don't get it'? Is there some guide during your teaching, that feeling of 'my learners understand or that …?

W: Ya. Sometimes like when I'm done with a certain topic, when I look back some of them start shaking heads but then some of them show that it's Ok. But, I try to ask them that "is that clear to all of you'? And now … I can repeat what I say.

H: I also noticed that boys and girls in that class are interacting easily with one another and the good thing to be very proud of, I didn't really seem to notice any gender bias where for example, in some classes boys have a tendency to just… to give answers… it seems in this class of yours those boys and girls seem to very (confident) … Is there any reason for that?

W: I don't think there is any reason for that?

H: Is that because perhaps the ratio is one to one. (*This class has equal number of boys and girls 15:15*).

W: Yes, you can say that. But, the girls, the girls (are) intellectual than the boys because every time I tried to do a classroom activity the girls finish faster (than the boys). But sometimes I usually asked them "boys, where are you?" Just because I'm used to boys being good than girls. But this time …

H: Yes. That's good to have a class where girls are better than boys. But are planning to do something about your boys so that they don't lag behind or so?

W: When I try to tell the boys every time the girls finish first. I'll tell the boys "you have seen now the girls are beating you, where are you? You have to prove that you are men". Ya, that gives them the courage to…

H: OK.

W: … to work hard.

H: Ya, last question but not least. I don't know, it looks as if your learners have a tendency to make noise while you are teaching or you just took it as part of communication?

W: No! That is still a problem then since this corporal punishment is abolished. That's why I always experienced problems in life to maintain order in the class. Anytime you … things that are not related to the topic and then …I tried like talk to them but me being here in the class or you coming to class, it doesn't mean you when you come to class you should … but you should obey as individuals … don't make lots of noise and disturb me. As I have told them "stay at home … couple of months without a teacher…"

H: So, you explained to them …

W: Ya, that's why I tried to tell them there …"lets try and get something.."

H: So, what are doing to … about that noise?

W: About that noise, I just talk to them and I don't like taking them to the principal to chase them outside. But, unless you do certain … then I have to chase them out of the class.

H: You can also tell them to keep quiet which I think you didn't do that much often!

W: (laugh) But I think I do that to other classes. Maybe it was like in that Mathematics (class) I usually give them time to … like giving them feedback. I don't really mind whether there is noise.

H: Ok.

W: But I always do that, especially with Physical Science.

H: That's it, thank you very much!

W: Thank you very much too!

END!!!

Interview No: 3 with Nuusiku

School C [H: Hileni & N: Nuusiku**]** 07 October 2005

H: Now, Mrs. Nuusiku I first of all, I really want to thank you for allowing me to sit in your class and observe your lessons. I just want to follow up some things ne, because sometimes it's never possible to understand everything while you are teaching. And I can also say that I enjoyed watching you teach. I just want to understand a few things. For example, how you were doing some things and the way you did them. But please, I'm not here to judge or comment on the quality of your lessons, no that is the issue. This (interview) is just to clarify certain things because I just sat there and observe …

N: Mmm

H: …what was going on. So, in this interview if I.., sometimes we may not understand one another during communication. Just feel free to say "what do you mean by that?" Then I can try to clarify the question.

N: (inaudible)

H: Yes. Let me start with your lesson presentation. In your lessons you were dealing with topics (such as) simultaneous equations …

N: Ya (yes)

H: And graphs ne?

N: Yes

H: Yes. Now, could you just tell me briefly how you decide on what method to use when you were preparing those topics? Did you think beforehand what method you were going to use when you were going to teach for example, the simultaneous equations?

N: Yes, when I taught simultaneous equations and there are two methods as you are aware of; the substitution method as well as the elimination method. Now, I have taught this topic before and when I prepare my lessons I thought, should I teach both methods? But the reason why I only taught them one method was because it confuses them. Because I also found that it is easier for them to understand the substitution ah, sorry the elimination method.

H: Mmm

N: As soon as I started now showing them the substitution method, they get confused. I think I showed them but not in that specific lesson. I said to them that "there is another method but I can show you how it looks". And I could tell by their reactions that they don't understand but they look confused. So, I'd rather stick to this one (elimination method).

H: So, you chose that method from your previous experience with the other learners?

N: Ya (yes)

H: Ok, let me also although I was not specifically referring to the methods as elimination process …

N: OK

H: I was thinking more about the way you present the lesson.

N: OK, that's a little bit a long time ago. I must now think how I presented the lesson. Mm, what I do is, I started first with a very two equations without … so that both variables have got the same coefficients. Is that what you mean? Can I explain this?

H: Ya, Ok!

N: Because if I'm not explaining this correctly just tell me that's not what you want.

H: Ok

N: What I do I, I normally use, I started of with having 2 variables, showing them (learners) that there is no way to solve either x or y with any other information. We need another equation in order to find values x and y.

H: Mmm

N: Then I started by only using equations with the same coefficient of the corresponding variables and then from there I… by making it a little more difficult where the variables do not have the same coefficients.

H: Mmm

N: And then I started by making the formula, the co-equation itself and not in the form x + y equals, say for example …what I also do for example, I give them notes with the steps. I don't know if you saw that, but I gave them notes with the steps that they should use and they should look at different things. When I prepare them (notes) I thought, I always put myself in the learners' situation or positions.

H: Mmm

N: Then I think that "what are the questions that could arise from hearing what I'm saying?" Then I answer those questions for myself and then while I'm teaching, I also continuously ask their opinions "what do they think of this; what do they think of that?" And then one of my things that I always do is, I explained to them what the word elimination means; explained to them what the word coefficient means because they don't always know.

H: I think, I remembered you asking them (learners) "what do we mean by the term elimination?"

N: Ya, that's correct! So then just to test their reactions, so what I sometimes do is, I want to eliminate, so it means I want to get rid off it. So I take both erasers and I just erased (both sides) and I asked them "is this the correct way?" Then they are quite shocked. "No Miss, you can't do that!" So, just to get them thinking you know, there must be a way to eliminate this variable before we can solve the simultaneous equations. Then I continuously remind them "your aim is to solve one of the variables, you cannot solve them at the same time with one of the equations".

H: Mmm

N: You must have only variable then you have got a linear equation, then you can solve the, the variable.

H: So, I'm correct to understand that when or before you go to class, during your preparations (time) you always try to put yourself in learners' shoes…

N: That's correct.

H: and try to think of what other things they (learners) probably don't understand if you were …?

N: Yes, correct.

H: OK, good. Do you usually use more than one method in your teaching? Like for example, I realized that for example, you come and write some examples on the chalkboard and then …

N: Ya (yes)

H: Is that the only method you used or do you also use other methods? The way you present the lesson?

N: Do you mean the method or do you mean the examples?

H: By methods I just mean the way you present your lessons in general.

N: Sometimes it depends on the learners' reactions. Sometimes they asked me questions then I tried to explain in different ways. Then it's actually open. So it is not part of my preparation but I'm always open to their questions. Sometimes they asked me, "but Miss, what if this number stands there?" Then I have got another problem I have to solve it.

H: Mmm

N: Then I told them "I have to solve it". So, it all depends on their reactions because I always encouraged them to ask me "Miss I don't understand this; Miss what if this happens". So then it's very open. When I've done my preparation… then I encourage them to ask me some questions.

H: OK, now when you were preparing to teach simultaneous equations for example, because usually that topic is problematic …

N: Ya

H: to some learners, did you think of any difficulties which your learners may encounter?

N: Yes

H: Did you think of …?

N: Ya, one of the difficulties is when they add or subtract one of the equations from the other one, a lot of mistakes is (sic) made by using, working with the negative signs. For example, when you subtract two equations and one of the variables has got a negative sign, they don't consider that as a negative. And when they subtract zero minus 15 for example, they do not write the answer as minus 15 but they write it as positive 15.

H: So when you come to class you have already prepared about …?

N: Ya, I think the reason for that is also previous experience. I've seen a lot of mistakes made by learners by marking examinations and working with previous classes on simultaneous equations. So that's the specific one (mistake) that they always made. The other one is, when they have to multiply two equations and both equations with the number, to get the same variable, they don't always know with which number they should multiply.

H Mmm

N: And the other problem that arises from that is, they don't multiply every term with that same number. So I always elaborate on 'every term' because whenever every time I talked about equations, I think I said this twenty times in the lesson, "the equation must balance". What you do with one term you should do it with every other term. What you do with one side of the equal sign, you should do on the other side of the equal sign. So I think those things are the biggest problems at this stage when I teach them. I give them …

H: Yes and what problems did you foresee when you were preparing to teach graphs?

N: The graphs is (sic) difficult in a way that they (learners) got to know y (or why?); what I did was I taught them the $y = mx + c$ is four letters now that they don't know what is going on. One of the other problems is to know which co-ordinate is x, which co-ordinate is y. And the first lesson when I start teaching the straight line graph is to give them a table with x-values only and then I gave them a formula which is for example, $y = 2x + 1$ and then they have to substitute the x-value in order to get the y-value.

H: Mmm

N: I found out that, when I heard this for the first time I think they are confused because … why you must do that …

H: You mean when they have to fill in the table using the formula?

N: Yes, that's right…

H: OK

N: when I use the formula. Then we worked out all the x-values. So when I taught that, I think I did that last week. When I taught that the first one they were very confused. The second one (coordinate) some of them they started to get it, then I thought… first I thought I'll only work out one and see how it's been done. But then when I looked at their faces it was just a bit … Then I continued, looked at them and then I thought it's not there yet. So I think the whole … it was about 6 or 7 values I worked out. Then I showed them every single value and I talked through the whole thing "your equation is $y = 2x + 1$. You put a number minus 2 in front of x" and then I continuously ask them and then they have to react and talk with me through the formula to… get the y-values. By the last one that they substitute most of them knew what was going on. So I could see that they are enlightened from the first one up to the last one because I made … through all of them.

H: OK

N: The next thing that arise now "what are you doing with these things, these numbers that we just worked out?"

H: They (learners) asked you that question?

N: No, they didn't ask but I, when I started to tell them what to do that was another confusion….

H: Oh!

N: But then I told them that the two x and y coordinates are actually an ordered pair. Then I, it is written in a table form in columns. Now, I write them next to each other. So that's why they end up confused. Then I showed them what is the purpose of doing this? We must plot it on the board and as soon as I started to plot them (points) then they understood.

H: OK

N: Ya (yes)

H: So at least you try to use two, I mean more than one way of explaining how to draw graphs.

N: Ya

H: OK. I also noticed that you used hand-outs when you … when I was there. How do you select what type of hand-outs to give to your learners?

N: One of the reasons why I give hand-outs is because some of them don't have textbooks.

H: Oh, they do? Are they sharing (textbooks)?

N: Some of them are sharing but the textbooks are not enough. For example, when we did Module 2 in my class of 35 only three students have Module 2 because we are working with modules in Grade 11. In Grade 12 we are using textbooks … Mathematics …

H: OK

N: Because this textbook is so expensive, we just couldn't afford to buy.

H: So you are making copies from this module?

N: Not necessarily. I set up my own notes.

H: Oh?

N: Yes and with the method that I used to set up my own notes I use the textbook as a reference but I don't only use one textbook. I use more than one textbooks. For example …

H: So, you use prescribed textbooks plus other books?

N: Yes, I used the *IGCSE Mathematics* that is prescribed.

H: Yes

N: And I used the Modules but sometimes …

H: Are these the Modules from the NAMCOL (Namibian College of Open Learning)?

N: Yes it is the same

H: OK

N: but the Cambridge Modules. There are 6 modules for HIGCSE and 4 for IGCSE. They are the same. NAMCOL modules are just a bit more explanatory.

H: OK

N: but because I also taught NAMCOL before, I used that as reference.

H: OK

N: Sometimes I also got some other books from the …(library?) just to get some exercises but maybe the method I used the way I set up the notes, the way that I teach them. What I said in the class I write down for them so it will remind them of how the lesson was presented.

H: Mmm

N: Then I try to use the same examples

H: I think that is good.

N: Ya, in the notes I used the same examples and then I make the also a worksheet or paper with homework. I also give exercise in class but I also give them homework which I also print on a paper.

H: Mmm

N: And this exercise I give them, this I give them from a textbook. Sometimes I don't write it on my own questions but my notes is actually copyright. It's my own I just presented it … it's my own.

H: Usually when you have a textbook, like now you said you have many textbooks how do you … I'm sure you are faced with deciding which one (to choose). What guides you to decide "I want this one and not that other one?"

N: What I use is, I think about the way that I work with the Cambridge examinations. Then I think how these questions are asked in the examination question papers. Because the way the questions are asked are mostly the same. And we've

worked out through a number of question papers already. I mean, I've worked out a number of question papers and then I know the question in the question paper is asked I this way so I'm looking for examples that will fit …

H: The examples

N: that represent the questions in the final question papers so that… So, that's actually what I look for. But sometimes you must also … your questions into a certain task and start easy questions and then later on …

H: Ya, so that the slower learners also have the chance to start with moderate questions.

N: Yes

H: OK, do you also use other teaching aids apart from hand-outs?

N: At the moment no. When we do geometry I(use) teaching aids like protractors and compasses but I just used the board and the hand-outs.

H: So you never tried to come up with other things they (learners) make themselves or other things you (improvised)?

N: No, not in the senior grades. In the junior grades we used to do that but not in the senior grades.

H: But not in the senior grades? How come?

N: You know, I think it is, it could always help them especially when it comes to geometry and polygons, stuff like that but the reason why I don't do this is there is no time.

H: Ya

N: I think it will be good for them to do practicals and to see things in practical. Oh I'm going to (contradict) myself, I do use it (teaching aids) but I don't let them do anything. I just show them for example, if I do surface area that's one area where they've got a lot of problems just to solve or work out surface area. So, what I do I take some of these are from home; I take some of the base tins or whatever and then I showed them the base tin

H: The …?

N: Base tin! I just showed them the cylinder and then I just showed them these things, you know. I just forgot that I showed them these things. I …

H: It's OK!

N: I showed them the cylinder and show that we have to work out the surface area. And then I explained to them what is meant by surface area and then after that I take off the label of the tin to show them that is a rectangle.

H: Ya, that's a good one.

N: Ya, it doesn't make sense to them because you have to calculate now the circumference of this tin to get the length of the label. So that they can get the idea that tin, the label around it is actually a rectangle and that is actually what we should calculate, the surface area of the area of rectangle plus the area of the two circles top and bottom.

H: Mmm (yes)

N: So, that is one thing that I do. Then I also take the cuboid and I just take the box then I just (take?) it apart and show them how many faces it got … and then we should calculate the surface area of each and every rectangle and then add them together to get the surface area. So, I think that is the only teaching aids I'm using at this stage just to help them because I found that it is difficult for them to see three-dimensional if they don't see the actual thing.

H: Yes. Now, when you were doing those kinds of demonstrations did you put them (learners) into small groups or did you do the demo to the whole class?

N: No, I just do demonstration to the whole class. What I also did was, that was when I was teaching Grade 9 class is to show them that pie (∏) is always a constant pie. Using a piece of thread or rope to measure the circumference of a circle and then working out the radius of circle that pie is always constant. But that was when I was teaching Grade 9.

H: Do you always use whole group (class participation)?

N: No, that one I did in groups … I did that one in groups.

H: … did with them different … We once did that (demonstration) with our students at UNAM (University of Namibia) and they were also surprised to see that pie is a constant.

N: The thing is we all get the same answer because we work with the decimals. Some of them got 3,0 some of them got 3, 9 and then they asked me "Miss, why don't we all get the same answer?" Then I just tell them that it is a human error.

H: Yes

N: It is very difficult to be exact when the human (person) is doing (calculations?) but more or less everybody got the answer.

H: Which is bringing in estimation, yes.

N: That's right.

H: OK. In most of the lessons that I observed you students usually did class activities individually. I didn't see any pair-work or group work. Is there any specific reason why you prefer them (learners) to work on their own?

N: You know, the reason why I don't like them working in groups is that they don't always do what you tell them to do. So, I know that is one of the things that is teacher-centered ah, Learner-Centred Education we mustn't do what we used to say, 'talk and talk'. We have to do Learner-Centred Education. But I find that it is difficult for me to handle because of the noise level as well as the, they don't always understand what to do. When the start talking to one another they go … they don't stick to what they are supposed to do.

H: Mmm

N: They (talk about?) weekends or they are not focused.

H: Even if you don't tell them to work in pairs?

N: Ya (yes). I have done that. I didn't do that when you were recording the lessons but I have done that previously.

H: So, it is easy to prepare …?

N: (inaudible)

H: It's fine, it's fine. Group- work also have their own weaknesses.

N: When I do, one of the things that I discovered over the past two weeks is that the learners they don' know that I know when they are not listening. So, when I teach them and I look at their facial expressions I can see that this person is not listening and I immediately ask him a question "what did I just said (sic) or what is the answer" and then they have no idea. Then I say that 'you are not listening" just to keep them on their toes all the time. So, that is also … because I can

see when the learner is listening or when he is not listening. But in groups you are not always aware of 'are they all participating'. If the group is large for example, is only one person that has got more knowledge

H: Yes

N: that can talk for the whole time. Then some pupils just you know are sort of cut out.

H: Yes

N: They don't participate, everybody is doing their work. Then I have a big … in front of them. I feel I must have control over everybody so that everybody can understand better.

H: OK

N: So that is actually … with group work.

H: It's fine, it's fine.

H: I also observed that you like working out two examples first and then you give classwork or homework. Is this how you usually teach?

N: Yes, I do that.

H: And why do you teach that way?

N: I think the more examples I do the better they understand that and then I give homework everyday so I expect them to learn from the example I do … do it at home or do it in the classroom either as classwork so that they must do it immediately so that they don't forget anything. That is the reason why I do one or two examples so just to remember.

H: I was thinking, have you ever thought of a lesson whereby not giving an explanation and not (giving) examples? I don't know how, but I'm just thinking, teaching differently?

N: Oh, I've never thought of that.

H: OK

N: Because I've experienced that the learners they forget very easily. I remember there were days I wanted to test the knowledge on the work I done previously. They can't remember anything, so I always start by giving them examples. Sometimes you know, I … on one day then I have already explained the previous day then I must just give them, they know what to do. For example, for today I planned a worksheet for them because I've explained yesterday the straight line graph and then I said to them yesterday "today you are going to do a worksheet.." I do not give them a worksheet in class so that they without any notes with them, so that I can see what … they don't understand.

H: So you went and assess what they were doing in class?

N: Ya, they do the worksheet as if they are doing a test.

H: Mmm

N: And then I just marked it and then from there I see if they understand the work or must I repeat the lessons.

H: Did you mark that (the worksheets) during the class or later?

N: No, I marked later but… still coming last week.

H: OK. I also noticed that some of the activities you do, you asked learners to explain things on the board.

N: Ya (yes)

H: Why do you think that was necessary?

N: I think the reason why I do that is also to let them participate so that they don't just sit there and maybe fall asleep. But I let them participate so that the other learners also can see if they make a mistake, what mistake is made and how must you correct it. Because somebody can make mistakes and then the others, you know sort of know now … they think the teacher is perfect, so the teacher won't make mistakes. So then they just know everything is all right. But when the learners do this examples, to answer questions on the board they are always wake up. If a learner makes a mistake they will say "No, Miss that is not right! No Miss, that is wrong!"

H: Mmm

N: My, my, how I deal with them I just say to them "just keep quiet, let him finish" because they start talking before the learner I finish with the whole question. SO I said to them "just keep quiet, let him finish and then you tell me if there is a mistake and what is the mistake?" So then, they'll say "Miss that is not right, this is not right" and then I'll say "who wants to come and correct the mistake?" So now they can all see what was the mistake and they can learn from the mistake.

H: I think that was good. I was really impressed with that.

N: OK

H: Especially the way you were asking them why and why they were thinking that was a mistake. I think that was really good.

N: Ya

H: Your learners were quiet most of the time. Is this how they usually behave?

N: Ya

H: They didn't make much noise. I visited other schools were learners made noise and screamed and do things like that while the teacher is in the class. But I noticed that with your learners they were quiet and very obedient. I don't know if I can put it that way?

N: Yes

H: Is that the way they would normally react or …?

N: No, is not the way. But they are not a difficult class at all. The last few days I struggled to keep them quiet, to get them to get their attention all the time but it is not very bad. It's the incidence from the time you were recording when you are not there anymore. And the other thing is, they told me "Miss we are a bit stressed, when is the lady finish recording?"

H: Ok!

N: So, that's actually one of the reasons why they were quiet.

H: Wow, this is very interesting because in the other classes, the learners wanted to make noise and to, like they wanted to be heard (and get noticed).

N: Ya

H: But from your … I was thinking is because of my presence …?

N: Yes

H: Wow!

N: I only received these learners in the second trimester. I didn't know … at the beginning that the time-table may change and then when I got them I thought this is actually a very good class. Not in a sense that … but they are well-behaved and there are sometimes when I could talk to them but is not that I could talk to them every single minute. And then whenever, my discipline is actually good also. Whenever I see a learner is not listening or for example, yesterday there were two girls sitting next to each other. I could see by their attention they are always busy with one another there so I said "the two of you, you come here. You sit here and one sits there". And then you know, then the classroom ….(said) "Ok Miss is serious, she does meant what he said". And then from there the discipline is also there.

H: So, sometimes you do have classes that are quite like …?

N: Yes, absolutely!

H: No, I just thought this class was too quiet! Now, mmh there is great deal of talk today in education about Learner-Centred Education as you just mentioned briefly. What are your views on this concept Learner-Centred Education?

N: As I already talked about this as you said, I think if we got smaller classes then it might work better. I'm sitting with 35 learners and the control is difficult. I like to be in control of my classes you know and a soon as I give them group work, learner-centred you know, then … I am talking about group work now. Then it is as if my control is not there anymore. But I also see Learner-Centred Education as involving them you know, not like I did working with them on the board or involving them in the discussion. When I do an example, and I've done a few examples so that I wanted them to talk with me for example, if I explain an equation, I will say "Ok this is your equation $2x + 5 = 8$, what must I do now?" Then they will tell me "Miss you must transfer that one to the other side". Ya, then I said "what else?" "Miss you must change the signs". So that's also I see also that as learner-centred because they participate, they don't sit there like a bunch of corpses and then they just wait for me to finish talking.

H: Mmm

N: They are always involved with what I'm doing. So I first show them examples and talk through the examples. So now and then I will tell them also to participate in getting the next example.

H: Ok, so do you think Learner-Centred Education means group work?

N: I will say so yes, but I think that is one of the aspects of Learner-Centred Education.

H: So, if you have to give the definition in your own words briefly how would you define that concept (LCE)?

N: It is very difficult.

H: I know.

N: The learner must be in the middle, the center is the middle, right? The middle of the discussion you know. It's bout the learner. They are the ones that has (sic) to learn and they are the important one. The teacher mustn't be the important one. The learner is the one that's all about I think. Maybe it's wrong but that's my view.

H: No, that's fine. Now, during your teacher training programme, you did teacher training programme? Were you taught about learner-centred approach?

N: No. That is now we have to teach ourselves about these things. What I did is, I think I already discuss with you I never studied Mathematics when I went to university. I studied music then I started to teach Mathematics without having any

qualifications and then three four years ago I started my HEP diploma in Mathematics with Open Learning. That is distance education, you don't sit in class with somebody teaches you, you know.

H: Mmm

N: So, then I one of the subject that is didactics, subject didactics and that is when I, it is not the first time that I came to now about Learner-Centred Education, but then …

H: When was that?

N: That was in 2002 to 2003.

H: OK

N: Then I start to realize you know, how should it be done (LCE?). But it's not, I got my notes and I have to study and I have to do assignments on it. That is the first time I actually was confronted with … (LCE?) education.

H: So during the 2002 and 2003 that is the time you did that didactic part?

N: Yes

H: Through distance learning?

N: Through distance learning yes! So, then I adapted my teaching so that what I think, what I'm doing is correct and it works! My record of teaching work because my learners understand and they like the way I deal with issues and they like the way I explain things to them. So to come back to my study then I learned I'm quite …(sure?) it should be but it's difficult with … because I was never assessed.

H: OK

N: And the other thing is, but maybe it's a bit (odd/off) but let me just say that the reason why I think I am a successful teacher is that I told you at the beginning that I put myself in the place of the students. But when I started to teach Mathematics I have the knowledge, but I have no experience of how to transfer the knowledge. So then I started to think but if I was a learner, how would I understand this?

H: Mmm

N: And from there I just I think I improved from year after year and then sometimes from what I see at other schools the teacher has got all the knowledge, the teacher is very (good) in the subject itself but the transfer of knowledge is not always successful because the teacher don't (sic) put himself in the place of the learner.

H: Mmm (yes)

N: And I have talked to many other students which is not … but it is Windhoek high School and the students always tell me "Miss, the teacher talks above our heads. The teacher knows everything but we don't understand" because they (teachers) don't start with the basics and that is one of my approaches when I teach. I start with the basics, you know. I do not start for example, when I used to teach Grade 10 I used to start with Grade 8 and 9 work then I start to teach Grade 8 from scratch.

H: And then you teach through (the whole syllabus of Grade 8 and 9)?

N: And then I teach through. I just do, I don't do very specific, you know. I don't do the topics … run through it but in such a way that they understand because Grade 9 is just n elaboration on Grade 8 and Grade 8 is an elaboration on

Grade 9. There is very few new topics. The only new topics on Grade 10 is (sic) trigonometry and …the place of the learner.

H: (inaudible)

N: Ya, that's part of it … but maybe the graphs. But when I started to teach Grade 11 (eleven) I did the same. So then I did the basics. I mean the learners they don't (know?) these things. They forget these things that is, the Lowest Common Multiple (LCM) and they have learned these in the previous years and then the other day I was doing Additional Mathematics class and I have taught them LCM. You start at the … you start with the multiple, you want the multiple. Then you work out the multiples first. Then you go to the next word 'Common'; which one of those multiples is common? And then you go to the (next word Lowest); which one of those common multiples is lowest? And then when I did revision with them I could actually see that they remember that and they could tell back to me that "Miss, this is how we should do it" which I think is (right because)when I talked with the (Grade) 11 about that then I use that method and they still remember it.

H: Do you think that perhaps most of us teachers have problems of trying to find out whether our learners or students understand and how best one can do that? (For example) when you find that "I am good at content but don't know how to pass that knowledge?" What is the best way to (teach)?

N: Ya, I think that it's good to talk to one another.

H: You mean other colleagues?

N: To other colleagues yes. To talk to other colleagues bout your experiences and there we just started a few weeks ago. We are all proud of class … and our school is part of cluster group school X, Y, Z and others. Can't remember other schools but we have seven schools in our cluster and we already have two meetings.

H: OK

N: The first meeting was, we are going to discuss whether we must have the same question paper or are we going to have each our own question paper?

H: Is that for the Grade 11 or …?

N: No, that is for the junior grades, Grade 8 and 9.

H: OK

N: Because Grade 10 they are writing now the National (exam).

H: OK

N: And Grade 11 it's difficult because we are not always at the same place with the syllabus. So, what we discussed at our cluster meeting the first time was, every subject go (sic) on its own and some of the Mathematics teachers are not going to have some question papers and we are going to talk about it.

H: Why?

N: And as we talked about it we realized that we've got all different kinds of problems and the problems that one of the teachers raised at the cluster meeting (was) to discuss the new syllabus Mathematics, the localized one.

H: Mmm (yes)

N: I don't know yet whether it has been approved.

H: OK

N: I got the syllabus from NAMCOL but …

H: Is that the one you just talked about, the one to be implemented?

N: Yes, the one to be implemented but we have not actually, we don't know whether if it is going to happen for real.

H: Yes

N: Because it is much more difficult than the present syllabus but anyway the one teacher said she has a problem of teaching three groups in one class. For example, the Grade 11 to 12 IGCSE extended, core and HIGCSE.

H: I understand.

N: We also talked about it in our staff meeting once and then I told them that I got a method that I think it works, you know. The extended work is more than the core but luckily in my class four of my five classes I only have core and extended. I only have one HIGCSE student. At the beginning I have three HIGCSE students.

H: Now this class which I visited, what combination was there?

N: Those are extended and core (learners) when you visited. But after the examination in August they decided they all want to do Core. Now, I'm ok but if I have a situation where some of them are Core and Extended, what I usually do is I finish the Core work and then the Extended must be further with the topics then I leave the Core work and give them worksheets which they have to do and we have decided in our school to start with (internal?) continuous assessment of the Grade 11 and 12 as well. So they have to be serious with their work and while I'm working with the Extended which is a smaller group, the Core learners has (sic) to do some worksheets and they have to give me those worksheets. I marked them and I give them marks for the continuous assessment. So I always tell them "it is not …that serious". So they can sit with the textbooks with the notes or whatever they got and used that to study.

H: You are talking about now (doing these thing) during class time?

N: Yes, during class time, during the time I am teaching, ya. This is also what I did with the Grade 12 when I was teaching the Extended pupils. I gave them worksheets and then what I actually did was I worked through the question paper so that they understand how to answer all the questions. So I gave them the exercises that they should do under different topics while I was busy with the Extended then I also do the same the other way round. When I have to explain something for the Core students, I keep the Extended (students) I give them worksheets or just an exercise from the textbook to do. So I never have problems with discipline.

H: Ya, because …

N: Because both have something (to do).

H: Yes, that is really challenging. Now during these classes that I visited do you think that you have been applying learner-centred approach in a way?

N: Yes, I told you a while ago that I've to involve the learners, is also learner-centred. So I think I have.

H: OK, now if I give you a rating of four where I put for example, where you have to rate yourself either all the time; sometimes; most of the time or we cannot say never because you said you have been applying LCE. So among those (three choices) where will you put your rating?

N: I think I will make myself at 'sometimes'

H: Why?

N: because I taught 'most of the time' (she laughs).

H: No, it is still OK.

N: Ya, ya.

H: Because I think you have a good reason for …? What do you think?

N: I think the motivation behind that is I …

H: Why do you think that you taught most of the time and …?

N: I taught most of the time because they (learners) are listening, you know and in Mathematics I find that if they listen more they understand better and then when you were recording the learners I actually have explained this, but sometimes I use half of the time. For example, if the period is 40 minutes I use 25 to 30 minutes to (teach) then I give them work to do in class so that they can continue with their work.

H: Mmm

N: So I think when you were recording I never actually put them into groups but I involved them by asking them questions and …talking and working on the board. But it is difficult to say why I'm getting 'most of the time'.

H: No it's fine.

N: I've never …

H: OK. Have you ever experience problems with this implementation of learner-centred in a way although you don't somehow use it in full?

N: ya

H: Now, suppose that day you have a feeling that you were doing learner-centred, do you think there were some problems…?

N: No, I don't think so because I don't allow them (learners) to be in groups. My … is less most less I just …

H: Suppose you are a teacher who believes learner-centred is about interactions as you have just talked about, do you think that has also some problems?

N: I think one of the problems is students not listening. That must be one of the problems because when I talked to them I saw some of them are not listening. I always ask the person who is not listening then I ask him a question. Then they have no idea what is going on in the class. Then I have to give to tell them "but why are you here?" and I have to give them the whole speech of "you have to listen otherwise you will not learn" and all that kind of things. So I actually enjoyed their reactions when I asked them questions and they react and sometimes not one reacts. Sometimes in Mathematics the quiet ones are those who cannot actually perform in Mathematics. They are scared to talk and they are scared others can laugh at them. And that is also one thing that I noticed in classes that when somebody gives a wrong answer the others make fun of him and I don't like that, so I said to them "everybody can make mistakes and we have to learn from the mistakes". Then I said to them "if you say the wrong answer it is OK to say a wrong answer. You must just keep on understanding why it is wrong and how must it be correct".

H: Now, how do you deal with the ones (learners) who are quiet if they are not good in Mathematics? What do you do about it?

N: …if I see that this person, you know sometimes I know the person (learner) is not good at Mathematics. Some of the mathematical … then I know this person has a history of actually not understanding Mathematics. I just talk to the person in such a way that the others won't …you know …

H: (ridicule?)

N: Ya, and then I would call that person sometimes to the board and I would do this example and then I want the person to tell me what must we do …and I will just help him guide him to say "Ok, this is an equation, what are the rules for solving an equation?" And then he must do it step by step and as soon as he makes the first mistake, I say "Ok, this is wrong, look at your problem and see why it is wrong". I just … and I help him but sometimes we don't always know what…

H: Yes

N: Because… and the problem arises when we've got a parents meeting then parents continue to say "but my child doesn't understand …" Sometimes not all the parents but I'm not always aware of it because the reaction I get … "yes, we understand". But there is always a (chance) they don't understand but they are afraid to speak up.

H: (inaudible)

N: They are afraid to speak up. So, it is then I have to encourage them "if you have a problem come and tell me". And then another problem which I noticed is time.

H: Mmm

N: You have to rush to get through your syllabus because I always plan to finish the syllabus by August if I am teaching Grade 12.

H: OK

N: But I am at 11 (grades) is one course, I will I plan to do after the ….(second?) topics in Grade 11 and then Grade 12 I want to finish by April.

H: So at your school you usually have that chance to carry over the Grade 11 and 12? (Continue with the same group of learners from Grade 11 to 12).

N: Yes, we do that.

H: Because at some schools where I taught for example, some other teachers were only teaching Grade 11 and other group was teaching Grade 12 which was very difficult.

N: We, if possible we try to carry them (learners) over. Sometimes a teacher goes away then it is not possible, somebody else has to take over.

H: Yes

N: But we try as much as possible also in other subjects to try … to work it out.

H: Now I am going to give you a scenario. Imagine I am a Headmaster and then I give out the instructions that I and all the teachers at my school to apply learner-centred (approach) in all the classes they are teaching. What will be your reaction?

N: If the principal says so, I must do it then you now, if the principal tells … and see what I actually do in my class and that's why I'm not very much into Learner-Centred Education, but if he really wants me to do it

H: Mmm

N: and check up on me I will do it. I will really make up a plan and found out more about Learner-Centred Education because I don't I am not, I don't have all that knowledge about how to implement it. So then I'll just have to make a plan.

H: So I think we have already talked about the challenging factors or do you think there are any? For example as I said, "I am principal and I want all my teachers to implement LCE in all the classes they are teaching". What do you think will be the most challenging things if we have to implement that kind of rule strictly, apart from group work?

N: Mmm, I think the most for me personally will be "how I'm going to do it?" I'll have to go and study some examples or go to other teachers and ask them "how are you doing it? Can I sit in your class and see what you are doping?" You know… not about the learner but it is also about the teacher. So I don't know whether I have answered your question?

H: Mmm, Ok, let me be more specific. Suppose, like now you were teaching simultaneous equations and graphs, what do you think would be the most challenging (factors) when you teach these topics and there is a rule that every lesson should be learner-centred? What can cause problems there?

N: I think it can slow the process when I … and I'm repeating … then we subtract the equations but when we have sum of the coefficients of the variables you must either … then you add or you are subtracting. That is also a problem that arises they don't know "must I add or must I subtract?" And one of the things that they also me is "Miss, must I add all the numbers or must I subtract the one for x and now we must add the y's"?

H: Mmm

N: So I think then I concentrate more on learner-centred but as I said they (learners) will forget what I said and then it will take them longer to understand. But that's actual … simultaneous equations because learners they forget very easily and then the other problem that we talked about is they don't have the (basics). You'll be shocked if I tell you they are still struggling to add numbers from one to ten.

H: (inaudible)

N: So the basics are no there and that lead us to the problem why the basics are not there. I want to blame the primary schools for that. The learners are not being taught the basics while in primary schools. When they get to the secondary school, the teachers sit with the problem. When the learners' basics are there I think it is easier to implement Learner-Centred Education. When it is not there (the basics) I feel like learners got more of a chance to understand it better if I teach and I'm repeating over and over and over.

H: Ok, I also noticed that you were using learners' background knowledge or experiences especially the day you were talking about graphs and I was really impressed. Why did you think that was necessarily to give some examples that they could relate on?

N: Ok, re you talking now about the …graphs?

H: I can't remember exactly which one, I just know it was about graphs.

N: I think it is because they could relate to the situation. They, I try to … and they can put themselves in the place of, say for example, I'm doing the 'travel graph' now that person is walking to school, they (learners) are also going to school everyday so they can relate to that. Then sometimes they can also forget their work at home and they have to go back then it is very much practical to use for me as an example because they relate to what I am doing there. And it is also real situation, it is not a fiction. It is real things that happened. It's not just something that is just said by somebody.

H: Now, as we said before I am correct to understand that you said that you could judge whether your learners understand by looking at their faces?

N: Yes, yes.

H: So that is how you normally tell that the learners are following what you are doing or they are not following/

N: Ya, ya that's right.

H: Ok, I thought that was good. Now, I could not quite easily tell in that class whether boys were more active or girls because I can only remember either one girl here or one boy there (raising a hand). Since that you know them better in terms of gender which group would you say is more active than the other one?

N: I think the boys are more active in that specific class because as the girls, there is only one who that, you know, is following better than the other girls nad there are more boys that would react.

H: Mmm

N: I don't, I can't remember what is the ratio of boys to girls. I'm not sure but I think the boys are more active than the girls.

H: Is it possible to give the ratio sometime, even over the phone?

N: I can do that.

H: Ok, that is for my statistics.

N: I can do that.

H: Thank you very much for your time and for the good responses.

N: It's OK!

H: Thank you, Bye!

END!

APPENDIX E

Raw data

3 Samples of transcribed video lessons

School A (Classroom A)

Lesson 6 Date: 14 June 2005

Ms. Ndapwa starts the class by writing the exercises (class activity) on the chalkboard. We wait a few minutes for the learners to arrive. She wrote 6 problems on the board.

T: I finish marking …(*walks to the locker and removes some documents. Calls some learners by their names and gives them their books*). Come quickly, come get your books (continues calling names). Here, I want you …listen … (*I cannot hear properly because of the noise from the class. Learners are talking among themselves, others are still entering the classroom and moving chairs*). I explained to you yesterday … I want you to come to the blackboard and do the things on the blackboard because some of you didn't do the work yesterday. So ... Patience, you get to do number one (pointing at the board) … yesterday.

Petrina: … Haa?

T: Where you not here? Who was here? Ok, Paul, number (a).

B1: Miss …?

T: Number (b)? (pointing to a boy sitting in front). Number (c)? Quickly, the time is short. In the meantime, the other people write down the things as we are doing the answers there already. Mmmhh..? After this period the people whose book I didn't see yesterday I want it. Worksheets … finish marking the worksheets and tomorrow I will give you the marks. (4 learners went to board and start doing the calculations). Ok, let's first see if the first one … mmhh the first one we have $3x = 2x - 4$. Let's see if this one is correct. (Teacher goes through the calculation). This one is correct.

(b) $5y = 3y + 10$
$5y - 3y = 10$

$2y = 10/5$

$y = 5$ (*learner's work*)

T: So, this one is correct! (*referring to the calculation abo*ve). Let's then look at this one here:

(c) $2y - 5 = 3y$
$2y - 3y = 5$

$y = 5$

$y = -5$ (*learner's work*)

T: Three minus 2 gives you what? Negative one, ne? (*Teacher goes through learner's work re-working the calculations*). We cannot write negative one, ne. So we need to divide both of them (sides) with –ve one so that we can get a +ve answer. So the answer will be –ve ÷ -ve gives you +ve. **y** is equal to –ve 5. Quickly, number (d). (Teacher calls another group of learners to do calculations on the board). Number (d), yes? Number (e), Maria? Number (e), number (f)?

[Note: (d) $p-8 = 3p$ (e) $3y - 8 = 2y$ (f) $7x + 11 = 5x$]

B1: …(*says something and the whole class starts laughing*).

T: You have to write down the answers, the correct answers there. (*Teacher tells the rest of the class to copy down answers from the board*). So let's see:

(d) $p - 8 = 3p$
$p - 3p = 8$

$-2p/-2 = 8/-2$

$p = -4$ (learner's work)

(e) $3y - 8 = 2y$
$3y - 2y = 8$

$-1y/-1 = 8/-1$

$= y = 8$ (learner's work)

T: We don't need to write -1y/-1, we just write y = 8.

B2: What about –ve eight?

T: If you take the –ve 8 over to that side it becomes +ve 8, ne! Can you see? If you take –ve 8 over to that side it becomes +ve 8. Then you have

$7x + 11 = 5x$

$7x - 5x = -11$

$2x/2 = -11/2$

$x = -5.5$ (learner's work)

T: Again, you take +ve 5x over to that side, it becomes –ve 5x. Then the +ve 11 if you take it over becomes –ve 11. Then 7 –5 is 2, then we divide both sides with 2. The answer will then be –ve 11 divided 2 gives you –5.5. You are finish here?

G1: Miss, I wanted to ask about example d?

T: Yes, I will … now.

B3: Miss… can I … now?

T: Yes, …? What is it? Give those … that question there, for example? (*A girl stands up and gave the teacher a piece of paper with something written on it. I think she has made some calculations on a piece of paper*). The other one, the first one. (*Teacher gives back the note to the girl*). We have 3 … = 21. Someone, do this one. Can you do it, Maria? And this is 4x –5 = 7x (*Teacher writes the more problems on the board ask learners to them on the board*). Moses? Moses (*Teacher repeats herself*), you also write?

Moses: I don't know. I don't understand …

T: You don't understand? And you don't want to try? Ha, Moses?

Moses: I will try tomorrow.

T: I … you understand because you did a lot of exercises already. Come, you two (referring to the other 2 learners) come! (*Learners start talking to one another. The other 2 work on the problems on the board*).

G2: Laimi, what happen to …?

Laimi: Minus, minus one.

T: Stop telling them. They must do it themselves. They should do it themselves. Write neatly (*telling learners who are writing on the board*). And now, why are you coming late? (*Teacher asks 2 boys who just walked in the class now-no*w).

B4: … hoe maak julle … vat my stoel? Hoe sien julle my? (*What did you do, taking my chair?*)

T: Come, finish quickly! Take all the x on one side … that x and this 4x this side. (*Teacher tells a boy writing on the chalkboard*: **4 (x – 5) = 7 (2x – 5)**]. No, no! Don't look to those people. You don't show him what to do, he must do it himself.

(*Most learners start talking among themselves. At least most of them are discussing the problems on the board, because others are just making noise, by talking about other things*. *Other problems include*: **4m + 2 = 5m – 8**. *T helps a boy to do the correct calculations on the board*).

T: Ok, I need you to look here! Mmhh, I need your attention (repeat). First, you need to get rid off the brackets. For example;

$3(p + 4) = 21$

$3p + 12 = 21$

$3p = 21 - 12$

$3p = 9$

$p = 3$

(*Teacher explains the correct procedures. There is an announcement through the intercom from the headmaster. Learners are not really paying attention to the announcement. Teacher continues teaching. Bell rings*).

$4m + 2 = 5m - 8$

$4m - 5m = -8$

$- \quad m = 10$

$m = -0{,}1$ (*learner's work*) (*Teacher gives the correct procedure*)

T: This is your answers. Tomorrow we will do simultaneous equations, tomorrow.

B5: Miss, miss …?

T: I need you to leave the books … those people I didn't mark your worksheets, you leave it here in class.

END!

School B (Classroom B)

Lesson 3: (double lesson) Date: 06 July 2005

T: Let's look at the test. What problems do you have concerning this test?

C: *(Start talking at the same time)*

B1: The first question.

T: Is the first question … the first question is just about …. *(T start writing on the board)*

L centimeters

U.B = 7.0 + 10/2 =

W centimeters

U.B = 15 + ½ =

T: And then the lower bound …

B1: We know how to do that, is only that question was …. for us.

T: For …. upper bound …

G1: For what sir?

B2: Upper bound.

T: Yes, because it said to the nearest centimeters. It was 15 cm to the nearest centimeters. Therefore, the error is one, while to the left error is 10. And then number 2 is part of what we are supposed to start with. But I just gave it to you because I know that in this class that's where I have all the genius people.

B3: And I was correct, you manage to practice.

That was good!

B4: Sir?

T writes the problem on the board:

Money

Given that $1 = 1547 DM, change 500 DM into dollars *($)* joining your answer to 2 decimal places.

T: Ok, this is what we have *(he reads through the problem above).*

C: Deutsh mark

T: Ok, and then we are given that 800, then we get *x* dollars here. Ok, and then you know this. *(T solves the problem on the board)* Multiply this by 1.545 DM and then this one $ by 500. So, that will give us

---

$$\$1 = 1.547 \text{ DM}$$

$$x = 500 \text{ DM}$$

$$1.547 \text{ DM}.\ (x) = \$\ 1 * 800 \text{ DM}$$

$$x = \frac{\$ * 800 \text{ DM}}{1.547 \text{ DM}} = \$\ \underline{517.13}$$

1.547 times *x.* Just put *(.)* for multiplication *(to avoid confusion)*

G2: Why don't we write like this *(x)?*

T: Like his? *(T rewrites x properly)*

And the multiply ...

L: By 800

T: And then for *x* … then you divide that.

(i.e. cancel out DM from numerator and denominator). Which would give you … one hundred and … point 13

B5: Yes.

T: … two decimal places. That was for number three. And then for the … loss,

That was Ok. Number 4, *(T reads the question)* I was surprised some people didn't get the 6.4 hours into hours and minutes *(This problem was done in class the other day).* We did it in class, that number 4. I just repeated it but still it was a problem.

T: For number *(a)* I think it is Ok! You got that?

G3: Number - three?

T: Number 4*(a)*? Number 3 that one is …

B6: Very very difficult.

T: Number *(c) (T reds the problem)*. You have already converted this *(6.4)*

To 6 hours and 24 minutes. And then you have the 22 hours 40 minutes

And then just add up the two.

G4: It's fine.

T: What is this? *(Asking the total sum of 6h24 + 22h40)*

B7: Two hours 4 minutes.

T: Mmmh? The next day, ne?

G5: *(inaudible)*

T: This calculation?

G5: Yes

T: Ok, then it is zero plus 40, or 40 plus24 and the you have 64 minutes …

G5: Yes

T: And then you know 60 minutes is 1 hour

C: One hour

T: Then subtract ths60 minutes from 64 then you have …

G6: 4 minutes

T: 4 minutes, and then you take this 1 hour *(carry over)* because here you have 60 and here it is times one, Ok. Add then add up this … 22 hours plus 2 hours that is 24. And then *(subtract)* 4 hours from 6 plus this other one hour is … Because 24 hours that is a completion of the day …. And then you are left with 4 hours plus this one hour … and that is 5. I hope you got that. *(Answer: 5h04 min)*

G7: I didn't write this.

B7: Me too.

T: And then significant figures. *(Teacher writes 21745. 1984)* Four significant figures yes, what is wrong? Can you do that?

B8: *(inaudible)*

T: The significant figures. What is this *(21745. 1984)* to 4 significant figures?

B9: Is 217500

T: Ya *(T writes 21750)* And then it was of interest, you give this *(21750.0000)*

C: *(laughed)*

B10: I'm the one, sir!

T: One of the people who got 100% wrote it like this. That is what I know and it should be you.

B11: Is wrong, sir?

T: It is not wrong, but this *(.0000)*

B12: Is not needed.

T: Ya, because it is just 0000. If you wrote it like this then you don't know what that means. Ya, just leave it like that *(i.e. 21750)* because if you have 1, you can write it as 1.0. But we leave out zero, we just write 1. Unless if you asked maybe to …. 2 or 4 decimal places than if you didn't have this than you can put the 4 zeros. But like this *(21750)* it was Ok. Ok, then your problem, what is that you don't understand? How we got this?

B13: How to … back?

T: … 4 significant figures. You count from your left 4 times to your right. Which is 1,2,3,4 *(referring to 2174<u>5</u>.1984)* and then you look at the next number, ya, it is bigger or small …

G8: It is five.

T: Ya, is it bigger or smaller than five? Is it 5, or bigger or smaller than 5? This is 5, therefore it makes 4, it adds 4 by one digit, which is 5. And then what happens to this number?

B14: Replace. by zero, don't just leave it; Susan!

T: Replace by zero, don't just leave it; Susan! Add zero you can ignore all of this *(i.e. . 1984)*

C: Aaah!

T: Because of the point.

B15: What if it was 217456789…

T: What if it was … 217<u>4</u>5658, Ok guys! And then you are asked …

B15: To convert it to 4 significant figures.

T: Then you count 1,2,3,4 *(up to <u>4</u>),* this separates …

B15: Sir, there is a point there

T: Where?

B15: After the 8, comma two, one. *(i.e. 2175678.214)*

C: *(laughed)*

T: Ok, then before the significant figures. 1,2,3,4 look at the next numbers. This is 5 therefore 4 add by 1.Therefore it would be 2175 and then you replace these numbers …

C: By zeros

T: By zeros, then you ignore after the comma. Ya, that's how it should be like, Ok!

B15: Now I understand.

T: Ya.

G9: What if there is a 4 and 5?

T: Where there is a 5 there is a 4? And then it will be just like this *(2174.0000)*

B16: One more.

B17: If there is no point?

T: If there is no point then you still have …

G9: What if they are all …?

T: If they are all …?

G9: Nine.

T: Nine. That means, you will have something like this *(99999.)*. And then for example to 4 significant figures, this is bigger then 5 then we will 5th like 100 000.

L: *(inaudible)*

T: If it is 4, then it will be 1,2,3,4 *(T counts displacement of a comma)*

This is still greater than 5 therefore this nine will add by one then it will just shift like that.

G10: What if …. between 1 and 7?

T: Between 1 and 7 here?

G10: Yes …. *(say something audible)*

C: *(laugh)*

T: Ok, if it was like this *(21.744678)* then you asked to 4 significant figures then you must …

L: *(inaudible)*

T: Impossible … No. you start counting from this. Remember I told you, after the point, if this one is zero then it doesn't count as significant but all these numbers are non-zeros. Therefore they count as significant. Therefore it could be 1,2,3,4 and then this is less than 5 therefore this remains as it is.

B18: …. after zero …

T: Yes …. Ok, this chapter is now at close stage … And they do this now *(T start writing and exercise on the board. The learners start to talk one another).*

T: Quiet please!

<u>Money</u>

1 pound = N$9.80 at Bank Windhoek

(i) How much in N$ can 268 pounds give?

(ii) How much in N$ can 150 pounds give?

(iii) How much in pounds can

(a) N$ 84 give?
(b) N$ 2500 give?

T: Try to do this.

L: Yes

B19: In our books?

T: Ok, do this now.

G11: Sir, we are writing now?

T: Writing?

G11: The questions.

G12: How much … *(reading the exercise)*

T: Ok, 1 pound is N$ 9.80 ….

B20: In pounds or in errors?

T: … How in N$ can 260 pounds give and how much in N$ can 150 pounds? How much in pounds can this give. If you have a problem just look at me then you will see the answer.

C: *(laugh) (They start working on the problems given)*

T: What happens to James?

B21: Shoopala?

B22: He is playing basketball and ….

T: He is playing rugby

C: Yes

T: I think I have to make time and go watch him playing.

B23: Sir, I heard you are good soccer playing.

T: Good soccer player? Aaye (no), who told you? If I was good soccer player I'll be playing with the Brave Warriors. And if I'm not, then you know … Are you done by now?

C: Yes … no:

B24: We are finish.

T: Then Hans came and do the first one. Continue with the other one, then will do the first one, while we are still …

B25: We're not yet done with the first one

T: Aa-aa, we are not going to wait for you. Do the first one, ya. Time is running, you it is winter these days. Days are shorter than nights

B26: I also discovered.

(Hans (a boy) stands up and walked to the board. T gives him the chalk).

B27: Do you know what is the speed of darkness?

T: The speed of …?

G13: How many days …?

T: Ok, it is like that but when you do it ne, just indicate. You know 1 pound.

<u>Learners work</u>

(i) 980 * 268
= N$ 2626.40

Is 9.80 therefore this 268 will be …. That in dollars.

Therefore this is equal that in dollars. Don't just write it like that. *(referring to Hans's work)*

<u>Teachers' work:</u> 1 pound = N$ 9.80

268 pounds = N$ 9.80 * 268 pounds

= N$ 2626.40

T: Then the 2nd one. Came and do the 2nd one.

B28: I'll come and do the 2nd one.

T: With your book?

B28: Yes *(He stands up and walks to the board)*

T: Do this …. yes, we are dealing with money.

(The rest of the class is still working and the exercise individually. Some learners are talking to one another).

B29: Sir, number 3?

Learner's work 1: (ii) N$ 9.80 * 150

= N$ 1470

(Some learners start asking questions. The bell rings! It is difficult to hear what they are asking due to the buzz sound of the electric bell. We have a double period).

T: Ok, Lungameni you can come and do number (b).

G14: No girls.

T: No girls? Ok, …

B30: The boys must not also go, man!

B31: Let me be trying!

G15: Let me …

(Two boys volunteer to do the calculation on the chalkboard. Learners start talking loud to one another. Class becomes noisy. Below is learners' work on the board)

(b) 2500 / 9.8
= 255.10

Learner's work 2: 84

9.80

= 8.57 pounds

T: Ok, the way how to go about it, first try to find 1N$ in pounds.

B32: *(Inaudible)*

T: No, it's not. If you just write it like this. What is this? *(T puts a cross on Learner 1's work who was doing number (b)).* You can say it is 255.10 dogs or hours! I don't know.

C: *(laugh)*

(Boy who did number (b) stands up and does the correction on his work). Class becomes noisy.

T: But if you just do it like this *(84/9.80)* the main point is to convert … Now why don't you just keep quiet please! If I may just also you, why do you have to divide by 9.80?

B33: Why?

T: Why, someone who is not doing Mathematics asks you, why are you dividing with 9.80, why not multiplying?

C: *(laugh because someone says something)*

T: Because of what? Doesn't know, explain why …

B34: The guy is not good at explaining, Sir!

T: Not good at explaining?

B34: No.

T: You are not good at explaining something only if you don't know.

B34: Explain it in Oshiwambo, mother tongue!

T: No, its not the problem of … Ok, you can go home, you tell your family members we learned 'money'. Then they will ask you, look in your books then they will ask you "Why did you have to divide?"

G16: Ya. *(yes)*

C: Because ….

T: That is not the point. That is not the ideas. Just because you change, it does not mean that you have to divide.

B35: And the exchange rate is high because …

T: That's why I wanted … If you do it like during your … exam next your when you do Grade 12, the examiner will not give you full marks.

G17: Why sir?

T: You have to explain how you got it.

G17: So we have to write it down?

T: Not write it down as such, but it is like this ne, 1 pound = N$ 9.8. In this case it was easiest because you have 1 pound = N$ 9.80. Therefore, for any other pound you multiply by this *(N$ 9.80)* because 1 pound is equal to this and then for 268 pounds you multiply it by N$ 9.80. Therefore, now you have to write N$ 1 in pounds. Ya, One Namibian dollars in pounds, what would it be?

G18: Zero comma …

T: It will be … One Namibian dollar is equal to … and then this is what you multiply with *(1 pound/9.80)*. That's why you were dividing! This *(1 pound/9.80)* is what you multiply with this 268. It is not just a matter of dividing. Therefore we were asked how will 84 dollars give? This will be ..

T's work

$$N\$\ 1 = \frac{1\ \text{pounds}}{9.80}$$

$$N\$\ 84 = \frac{1\ \text{pound}}{9.80} * N\$\ 84$$

= 255 pounds (8 pounds.

T: What is it? *(T made an error during calculation)*

B36: You are confusing us.

T: I'm not confusing you. You have to divide with your calculators.

B36: The answer is …. It the answer you put these before that one.

T: If you have asked me what the answer … you're the one who is confusing me, not me.

B36: Ok! Ok!

B37: Sir, what if I just put the 84 …?

T: It is the same thing. We just wanted to know **why** they were dividing and then now if someone asks you 'why are you dividing' you have to him that because 1 dollar becomes, is given like that. That's why you multiply this by 84. Therefore you …. divide by 84. (T cleans the board)

T: Ya, if you multiply this by … (T writes another exercise on the board)

Example : A car uses 40 liters of petrol in traveling 280 miles. How much will be used on a journey of 87 miles. Where 1 mile = 7 liters.

T: Who like to stretch his brain to work this thing out?

C: (inaudible) A boy stands up from the back and does the calculation on the board.

B38: He must explain.

T: Quiet.

B39: Explain

B40: I will explain to you now (Boy who is writing on the board).

<u>Learner's work</u>

(i) 280/40 = 7*l*\km
(ii) (87 km) 1 mile = 7*l* * 1/7 * 87
= 12 *l*

T: You know what? The easiest is this formula (referring to the previous example of pounds). Try to find, one liter how many more miles will you need to … how many miles are they to these liters? For one liter you divide by … (T tries to help the boy doing the calculations on the board).

B39: I'm confused.

T: Then just do it the way … I rest my case.

(Some learners start discussing the problem among themselves. Others are busy talking irrelevant things sp. boys at the back. T talks to the learners sited in front.)

T: Ok, listen let him explain now. No, I just want you to explain. I don't know whether it is Ok or not, I just want you to explain. (B39 looks unsure about his work)

B39: …. If you travel 40 km how many, how much, how many liters will I use for 87km?

T: Miles!

B39: Miles. So …

B41: Speak up! (Class makes noise)

B39: … divide 87 by 7 you get 12 liters ..

T: The you put these 7 liters here, it will cancel out with this one here.

B39: I don't understand …

T: If you don't understand why don't you …

B39 (re-writes :)

(ii) 1 mile = 7 liters = 1/7 * 87
= 12 liters

T: You said, one mile is equal to seven liters and then is equal to this (12 liters)? One mile gives you 12 liters. That is what you have written now!

B39: (explains 5th, inaudible. Goes and sits down).

G19: (A girl stands up to a solution)

T: Listen now.

G19: One mile is equal to 7 liters … (she writes and explains what she is doing)

<u>Learner's work</u>: 1 mile = 7*l*

1 liter = 1/7 mile

87 miles = 1/7 mile * 87

87 miles = 12.4*l*

C: What?

B42: Genius!

T: Ya. This is how it should be. Just listen.

(Girl 19 starts explaining how she arrived at the answer. The class start talking and makes noise. It is difficult to follow the conversation.)

B43: We just need the short cut.

T: You don't understand? What is the problem?

G20: The problem is there ….

T: This seven?

G20: Ya.

T: You are given this seven liters and one liter because for 1 liter you have something like this (1 mile / 7 = 7*l* / 7) and then you divide by seven for you to get 1 liter.

B44: Now, divide …

T: Ya.

B 45

& 46: Is that the only method, Sir?

T: Ok, for 1 mile you have that (7 liters) and for 87 miles it becomes like 7 liters times 87 miles equals …. What will that give you? If you were given something like … what is this now?

G21: Six hundred and nine.

T: 609? Ok, like this. The problem is now this. We have 1 ml for 7 liters, Ok for 87 miles it is equal to that.

<u>T's work:</u>

1 mile = 7 liters

87 miles = 7 liters * 87 miles

= 609 liters

Learners talking at the same time, making noise

T: Quiet, one person at a time! 1 mile 7 liters, 2 miles it would be …

C: Fourteen

T: For three (miles), three times seven (is) twenty one …

B47: It's like that, Sir?

T: Ya, it's like that. Then for 7 miles it will be that much (pointing at the answer)

B48: Hey, one at a time man!

G22: Because it is … divided by seven … (Using her calculator).

B49: Sir, how much is that …?

(T tries to explain something, learners are talking at the same time. The class becomes noisy).

T: Ok, sorry! (T rewrites the answers)

B50: Yes!

T's work; 40 liters = 280 miles

I mile = 7 liters

40 liters = 280 miles

87 liters = x (rewrites) as

40 liters = 280 miles

x = 87 miles

for 1 liters = 1/7 mile

87 miles = 87 * 1/7 = 12.4 L

G22: I don't understand

B51: I'm lost, I'm very much lost.

T: Happy now? This is for the x liters in miles. That will give you 12.4 liters.

L: (inaudible)

T: Impossible, not possible … you have 280 …

G23: Sir, sir …? (T did you not notice this girl, she looks desperate)

T: This is just a question and then for 87 it will be much less than this. You have something else. You want to try something else, Ok.

T's work 1 liter = R12.45

x = R200

1R = 1/12.45 L

R200 = 1/12.45 * 200 = 16.1 L

T: For one liter … therefore it will be more liters for R200. for one rand it will one divided by … Therefore for R200 you'll buy 16.1 liters. The Zimbabwean kwacha will be done for tomorrow. Now let's try for .. tomorrow …. why are you sleeping (Class is still too noisy. T explains the last calculations of R200 again. It is difficult to follow the conversation with this noise). T sits down and starts looking at some learners' work.

The class becomes chaotic! There are some announcements thru the intercom. Nobody pays attention! Bell rings!

School C (Classroom C)

Lesson 6 (Topic: "Travel Graphs") Dates: 15 September 2005

The teacher greeted the class and started cleaning the chalkboard. She re-drew the graph of yesterday lesson (14.09.05).

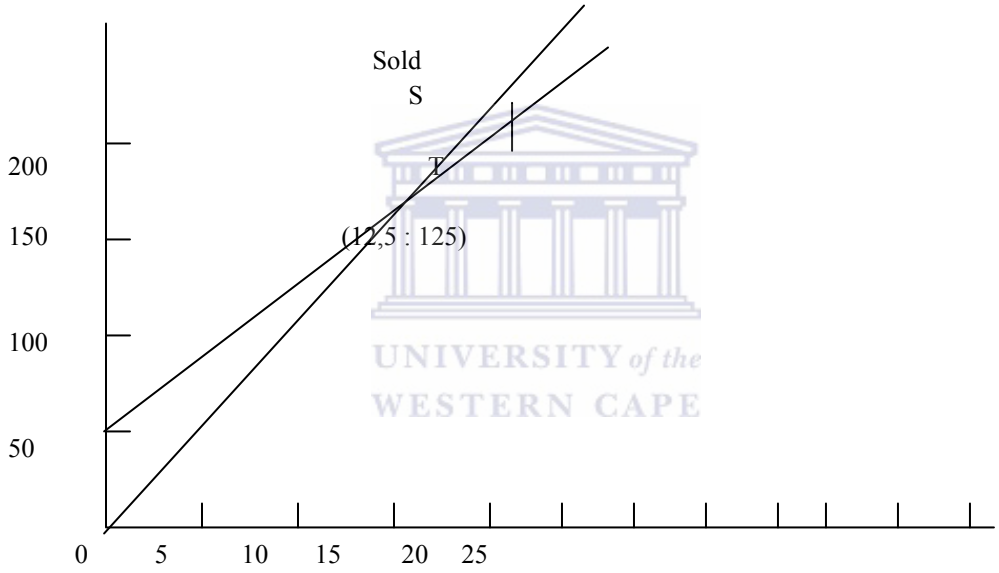
T: Good morning, sit down!

C: Good morning, miss! (*chorus*)

T: Did you all draw the graph correctly?

C: Yes! (*chorus*)

……



……

T: Yesterday we said that … (*she drew the table for the graph above on the chalkboard*).

……

0	5	10	15	20	
0	50	100	150	200	

……

T: OK, what is the graph all about? The second graph that we … What is this graph representing?

L: (*inaudible*)

T: Yes, it is the number of discs sold. So each disc costs 10 dollars. So 5 discs will cost …?

C: Fifty thousand

T: Fifty thousand, and 10 will costs?

C: Hundred thousand

T: Hundred thousand, and 15 will cost?

C: 150 thousand

T: 150 thousand ,and 20 discs will cost?

C: 200 thousand

T: 200 thousand. Are you all with me so far?

C: Yes miss! (*chorus*)

T: Now, the next question is "how many discs must be made and sold before you make a profit?"

B1: 200 thousand

T: How many discs must be made before you rich the profit?

B2: 20 discs

B3: Five thousand

G2: Five thousand

L: 20 thousand

B4: 20 thousand

B5: Five thousand

T: OK, before you decide … answer correctly, what are we looking for?

B5: Profit

T: Ya, we are looking for the profit.

B7: 20 thousand

B8: 10 thousand

G3: 12 thousand

T: What happens at the place where two graphs meet?

B8: Equal

T: What is equal?

B9: Equal is … to the number of …

B10: Is given …

T: OK, you are practicing Economics and Accounting, ne?

Boys: Yes! (*chorus*)

T: …that part of my knowledge is non-existent … that means, I think you know what it means, ne? That is the point where the number of discs that you sell is equal to the number of discs; the cost of the number of discs ne! OK, let us write it down.

B11: Yes

……

Teacher wrote down the following on the chalkboard:

Cost of discs = number of discs sold

……

T: The cost is equal to the number of discs sold. Cost of the discs is equal to the number of discs sold. That means … first of all, find this point (*where 2 graphs meet*) on your graph. I want you to find the coordinates of the point where the two graphs meet. Give me the x-value as well as the y-value.

B12: Twelve point

G4: Twelve point five

T: Twelve point 5 and y is?

G5: Hundred and …

B13: Hundred and twenty-five

T: One hundred and twenty-five, OK. So, what does this stand for? 12, 5 is the ..?

B14: (*inaudible*)

T: Number of discs and what is it in thousands?

C: Twelve thousand … (*chorus*)

T: Twelve thousand, five hundred. So, 12 500 discs and it costs you?

B15: One hundred and twenty-five thousand.

T: One hundred and twenty-five thousand dollars, OK. Then what is the question? "How many discs must be made and sold before there is a profit?"

G5: 12 thousand…

B16: 12 thousand and five …

T: Twelve thousand, five hundred that's right! Because if you make less than 12 discs you will not get a profit ne! So, everything from 12 thousand and 500 is the least amount of discs that must be made in order to make a profit. That means … you are in a commercial field because you understand much better. The last question "If 8 000 discs are made and sold, how much profit is …?" I'm sorry, it is 18 thousand (*T read through the problem correctly*). You must now look for 18 thousand where?

B17: (inaudible)

T: On the… which axis?

C: x – axis (*chorus*)

T: X- axis, ne! So your 18 thousand is there. What am I looking for now?

B18: y –axis

T: On the y-axis, I need what? From this axis (x- axis) 18 thousand to the graph of the cost of the discs, ne; what does it indicate (on the y-axis)? If you look at this line here from 18 thousand to this line, the line that indicates the … cost of discs made? What does the y-coordinate tells us?

C: 158; 160; 150; 168; 158 (*chorus*)

B19: One fifty-five

T: OK, my question is what? I didn't ask you to … What does it tells me about that amount? If I have 18 thousand discs is made … read from this line here, what does it tell me? It costs what?

B20: …cost …

T: Costs what, yes?

B21: (*inaudible*)

T: Yes. That is the cost of this made, ne. … I ask you the next one; what does this one tells you?

G6: Sold

T: Yes, this is the discs sold, this one! What is the coordinates? Ya, what do you find?

G7: (i*naudible*)

T: One and …?

B22: Ninety-five

B23: One eighty

T: 180 and what is this one?

B24: One sixty-five.

G8: One sixty …

B25: One …

T: Let's look at this quickly. Are you … remember that the x –axis is indicated in … every second unit indicates one disc ne. If that is 50, 60, 70, 80, make sure that you are on the right unit, ne! And then you take your ruler vertically and put it next to the … 80 then you make sure that you've got the right graph in the eye. Then you turn your ruler like this, vertical to see where it meets the y –axis.

B26: Two blocks from the …

G9: One sixty

B27: One hundred and sixty

T: 160 ne, more or less 160. OK, now what does this distance tells us? (*The distance is marked ST on the graph above*).

G10: Profit

B30: Profit

T: It is the profit. But how do I get the profit?

C: (*chorus, inaudible*)

T: Yes! 180 minus 160 thousand and the profit is …

C: Twenty thousand! (*chorus*)

T: Twenty thousand. It's more about economics, ne! Even me I didn't know about … OK, that's it.

B31: That's it!

T: This is example 4, the next graph is about 'travel graph'. At the moment we don't have examples that … the travel graph. These are all conversion graphs. I gave you homework but we will look at it some other time. Can I erase this?

C: Yes! (*T cleaned the board and wrote the topic 'travel graph'*).

T: The word travel comes from … travel. What does it mean, to travel?

C: (*inaudible*) … travel.

T: To move from one place to another, OK! We normally use distance and time to indicate travel graphs, ne. Distance and time will be our axes. Say for example, I have 2 examples here (*from the textbook*). "You walk from your home to the bus stop 1 km away …" (T read the problem). Now, we want to indicate that on the graph. First of all, you don't need the negative axes, ne. You only need the positive y. Shaanika?

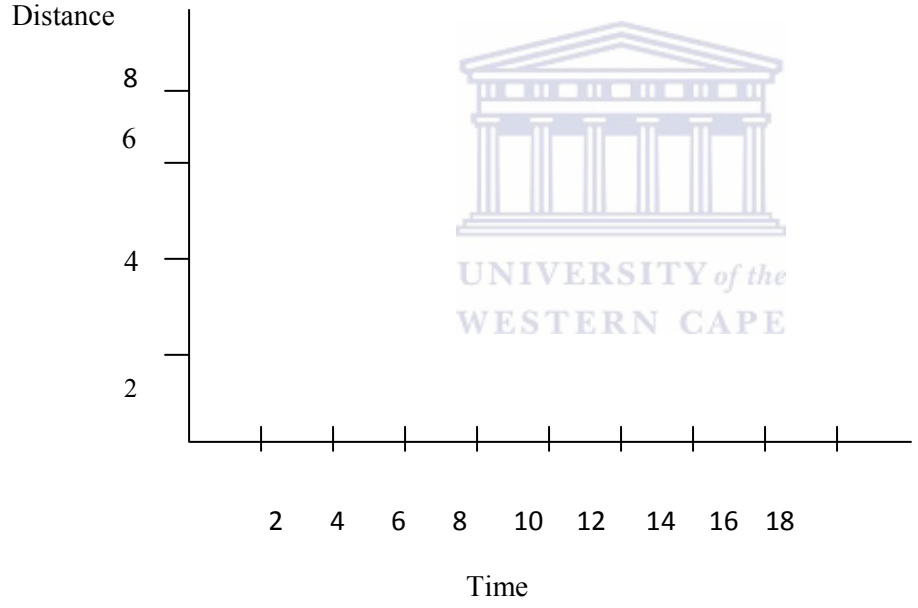
Shaanika: Miss!

T: Pay attention please!

Shaanika: Yes, miss!

T: You only need the positive x and y axes, ne. So, we can make our … our y- axis is distance and x –axis is the time. (*T drew the graph*).

……



……

T: The first question says, "You walk 4 minutes from home to a bus stop 1 km away". Which units are we talking about?

C: (inaudible)

T: You can copy down this and make use of this. Four minutes and 1 km, what does this tell you? Which units are you going to use on your graph?

G11: Minutes

T: Minutes and …?

C: Kilometers! (*chorus*)

T: Kilometers. Let's see! One, two, three, four, five, … (*T labeled the axes*). Now, you have to know exactly how much … because I'm going to divide this axis into two. That means, 2 minutes every unit indicates 2 minutes, OK. Now, what is going to happen when I … draw the graph? It takes you 4 minutes to walk 1 km. Who want to come and show me on the board where to plot the first point? I want to … on the graph … I walk 4 minutes 1 km. Ya, come! (*A girl stood up and after a few minutes T continued*).

T: Ok, look at Anna what she puts on the board. Four minutes and one km but there is no graph there! This is just a point, so what you have to do to draw a graph, you have to draw a line from the origin to four and one. The next thing what happens is (*T read the problem*), "You wait for 2 minutes for a bus, 2 minutes you wait". Now, did you move anywhere in this 2 minutes?

B32: No!

T: No. OK, but did the time stands still?

C: No! (*chorus*)

T: No, the time moves. So, what is the distance it traveled?

B33: Five minutes

C: Zero

T: But I just asked you the distance it traveled and you said no! So, are you giving me (*the distance*)… it traveled?

C: No! (*chorus*)

B34: Zero point …

B35: Zero

T: In the two minutes, not in the 4 minutes. We are busy with the 2 minutes …

B36: Zero point zero zero …

T: Did you move anywhere?

C: No! (*chorus*)

T: No, you didn't! So, how many km did you move?

C: (inaudible)

T: No, so what is no?

C: Zero

T: Zero … because you are stationary, you didn't move from the bus stop to anywhere else. You sit and waited but your time didn't stand still. Your time went on, OK! So, any volunteer who wants to indicate on the graph how to show on the graph that you waited 2 minutes. Come, Titus! (*A boy stood up*). I also want a graph not just a point, ne.

C: (*laugh*) (*Titus put a point on the graph and it was wrong*).

T: Anyone with another idea? Ya? (*Another boy stood up*). OK, which one is incorrect?

G12: The first.

B37: The second one.

T: The second one or the first one?

G12: The first

B37: The second one.

T: OK, initially what happened ne, he draws point one and two. That means if he has to draw a graph between that one and this one (T joined the points) you move back to your place and it took you 2 minutes, that is what this graph means.

C: (laugh)

T: But, what Elago did was, you waited for the bus, you really spent 4 minutes. From where you are, you waited, you didn't go back to the beginning to wait from where are waiting 2 minutes. Then 2 minutes from 4 minutes to 6 minutes is 2 minutes and distance is zero; that's why this line is horizontal because you didn't..

C: Move

T: Move means the graph must go up.

B38: Up

T: But, when it stays on the same level there, then it means you have stay stationary. Do you understand this?

B39: Yes

T: OK, you see what is happening, ne? (*The bell rings. Teacher disperses the class)*

END!