WHAT CAUSES LEARNER MIGRATION FROM MATHEMATICS TO MATHEMATICAL LITERACY IN SELECTED SCHOOLS IN THE NORTH-WEST PROVINCE?

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DISSERTATION SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE *MASTER OF EDUCATION IN EDUCATIONAL MANAGEMENT* AT THE MAFIKENG CAMPUS OF THE NORTH-WEST UNIVERSITY

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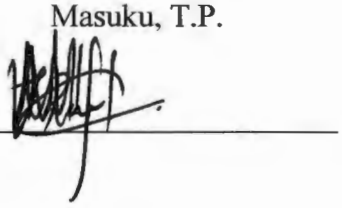
DECLARATION

I, Thandeka Precious Masuku (18045553) declare that this dissertation submitted in fulfilment of the requirements for the degree of Master of Education at the Mafikeng Campus of the North-West University has not previously been submitted by me for a degree at this or any other university, that it is my own work and that all sources quoted have been indicated and duly acknowledged.

Masuku, T.P.



Date

17-04-15

CERTIFICATE OF ACCEPTANCE FOR EXAMINATION

This dissertation entitled: **"WHAT CAUSES LEARNER MIGRATION FROM MATHEMATICS TO MATHEMATICAL LITERACY IN SELECTED SCHOOLS IN THE NORTH-WEST PROVINCE?"** written by Thandeka Precious Masuku (18045553) is hereby recommended for acceptance for examination.

Supervisor: Professor C.B Zulu

DEDICATION

This dissertation is dedicated to my fiancé Alvino Comole, my son, Loyiso Comole and my mom Jabulile Masuku who have been my constant source of inspiration and pillar of strength. They believed in me and gave me the courage to undertake this study with discipline, enthusiasm and determination. Without their love and support this study would not have been possible.

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Lastly, I offer my regards and blessings to all of those who supported me in various respects during my study. It was not easy, I thank you all for your support.

ABSTRACT

This study investigated causes of learner migration from Mathematics to Mathematical Literacy in the selected schools in the North-West province. A concurrent embedded mixed method design was followed in this study. Three schools of Rekopantswe Area Office in Mahikeng (North-West province, South Africa) were randomly selected, and the target group were learners and teachers of Mathematics and Mathematical Literacy subjects. Data were collected concurrently. Quantitative data were collected by means of a structured questionnaire which was administered to teachers and learners. The quantitative component of this study consisted of a sample of 93 learners and 6 teachers from the three selected schools and the Qualitative component consisted of 3 Heads of Department and 6 learners. Qualitative data were collected by means of a semi-structured interview of Mathematics Heads of Department and journal writings from two learners per school.

In the qualitative phase, the text data obtained through the interviews and documents was coded and analyzed for themes. Inductive and typological models were used in data analysis. Inductive model of data analysis allows the researcher to identify themes that emerge from the data. In an inductive model, themes emerge from the data not from predetermined categories. In a typological model, themes or categories are predetermined. Typological analysis involves dividing the data into categories or groups. In the quantitative phase, data were analysed by means of descriptive statistics. The results were summarized and displayed in graphs and tables. Frequency analysis was conducted to identify valid percentages for responses to all the questions in the questionnaire.

The main findings on causes of learner migration from Mathematics to Mathematical Literacy were: failing and repeating a grade, poor foundation of Mathematics in the lower grades as well as

in Grade 10, learners' perception that Mathematical Literacy is an easy way out of Mathematics, learners not practising Mathematics every day and teachers' teaching strategies in Mathematics. It is therefore recommended that continual teacher in-service programmes be provided by the Department of Education; support and monitoring of teachers with the aim of teacher-development should be done; SMTs in the schools should hold career guidance fairs at the beginning or middle of Grade 9 to help learners to choose the correct subjects which will be aligned with their careers.

KEY WORDS

Mathematics

Mathematical Literacy

Learner Migration

LIST OF ABBREVIATIONS

ANA	Annual National Assessment
ANC	African National Congress
ASIDI	Average System Interruption Duration Index
CAPS	Curriculum and Assessment Policy Statement
DBE	Department of Basic Education
DBSA	Depression and Bipolar Support Alliance
DoE	Department of Education
FET	Further Education and Training
HG	Higher Grade
HoD	Head of Department
HR	Human Resource
M/Maths	Mathematics
ML	Mathematical Literacy
NCS	National Curriculum Statement
NQF	National Qualifications Framework
OBE	Outcomes Based Education
PISA	Programme for International Student Assessment
SACMEQ	Southern and East Africa Consortium for Monitoring Education Quality
SAMF	South African Mathematics Foundation
SG	Standard Grade
SMT	School Management Team
TIMSS	Trends in International Mathematics and Science Study

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CHAPTER ONE

ORIENTATION

1.1 INTRODUCTION AND BACKGROUND

In 1997, educational reform in South Africa was heralded by the introduction of the new curriculum framework, Curriculum 2005 (C2005) (Department of Education, 1997: 62) and later the National Curriculum Statements in 2003. These curricula were designed to address the disparate and poor quality of education that many South African learners had been exposed to in the past (Department of Education, 2003: 5).

International and national studies have revealed the poor Mathematics skills of South African learners. The performance of Grade 8 learners in the Trends in International Mathematics and Science Study (TIMSS) of 1995, 1999 and 2003 (in Howie, 2001:123; 2004: 67; Reddy, 2006:98) revealed that South African learners had the lowest scores amongst 40 countries. Although there may have been criticism against some of the procedures followed in these studies (Dempster & Reddy, 2007:72; Vithal, 2008:49), the results remain a serious concern. The concern regarding this state of affairs seems to be around one primary factor: education quality (Howie, 2004:85).

The call for students with a flexible range of quantitative skills that can be applied in a diverse range of contexts has gained considerable ground internationally over the last decade or so (Kilpatrick *et al.,* 2001:167). Steen (2001:6), a key American proponent of what he terms 'quantitative literacy', suggests that in everyday life and work situations, the knowledge and skills involved are related to, but different from those associated with traditional Mathematics learning: Whereas the Mathematics curriculum has historically focused on school-based

knowledge, quantitative literacy involves Mathematics acting in the world. Typical numeracy challenges involve real data and uncertain procedures but require primarily elementary Mathematics. In contrast, typical school Mathematics problems involve simplified numbers and straightforward procedures but require sophisticated abstract concepts. The test of numeracy, as of any literacy, is whether a person naturally uses appropriate skills in many different contexts (Steen, 2001:6). A Mathematical Literacy programme, aiming to address this area, and offered as an alternative to the Mathematics programme, has recently (January, 2006) been introduced in Grade 10 classes (learners generally aged 15) across South Africa.

This programme is intended to run across the Further Education and Training (FET) phase – Grades 10-12, and will lead to a Mathematical Literacy qualification that is viewed as suitable for learners who wish to proceed onto courses at higher education level that do not have a significant mathematical content, or into vocational courses or employment. Mathematical Literacy qualifications at FET level have been available within the adult learning sector since 2001, but this paper focuses primarily on the current school-based introduction of Mathematical Literacy, incorporating the more general aspects of critiques that have been undertaken of the programme on offer in the adult sector.

Mathematical Literacy has been defined within the South African National Curriculum Statement for the FET phase in the following terms: "Mathematical Literacy provides learners with an awareness and understanding of the role that Mathematics plays in the modern world. Mathematical Literacy is a subject driven by life-related applications of Mathematics. It enables learners to develop the ability and confidence to think numerically and spatially in order to interpret and critically analyze everyday situations and to solve problems" (Department of Education, 2003: 9).

1.2 STATEMENT OF THE PROBLEM

Mathematical Literacy has a rapidly growing number of learners in most South African schools. In 2009 learners who wrote Mathematical Literacy Grade 12 final exams were 277,677 and those who wrote Mathematics were 290, 407, in 2010 only 263,034 wrote Mathematics while 280,836 wrote Mathematical Literacy (Equal Education, 2012). Again, in 2011 there was significant decrease in mathematics because only 224,635 wrote and Mathematical Literacy had an increase since 275,380 wrote (Equal Education, 2012). According to my own observation, learners who are doing Mathematics in Grade 9 migrate to Mathematical Literacy when moving to Grade 10, others changed their minds in Grade 10 and 11. As a result, in Grade 12 there are few learners in Mathematics compared to Mathematical Literacy. That is, Mathematical Literacy learners' outnumbered Mathematics learners by 55% in the final exam of 2011 while Mathematics followed by 45% in the whole country.

From 2010 to 2011 the number of learners doing Mathematical Literacy has increased and is still expected to increase by 1% or more than in 2012. Unfortunately, there are multiple challenges that cause these learners to migrate or move from Mathematics to Mathematical Literacy. Barriers such as language (Mathematics terminology), low self-esteem and societal beliefs may influence the learners' migration. Failure to obtain preventive strategies can increase the number of learners moving from Mathematics to Mathematical Literacy. As a result, the country will run short of learners who are doing Mathematics and who could pursue careers that require Mathematics such as engineering, chartered accountant, doctors etcetera. Therefore, this study will investigate the causes of learner migration from Mathematics to Mathematical Literacy in selected schools in the North-West province.

Having stated the problem, the aim and sub-aims of the study are given.

1.3 AIM OF THE STUDY AND RESEARCH QUESTIONS

The aim of the study was to establish why learners migrate from Mathematics to Mathematical Literacy. To achieve the aim of this study, the following research questions were posed:

- What is the nature and extent of learners' movement from Mathematics to Mathematical Literacy?
- What causes the migration of learners from Mathematics to Mathematical Literacy?
- What strategies may be devised to manage the problem of migration of learners?

1.4 SUB-AIMS OF THE STUDY

In order to answer the research questions, the following sub-aims were stated:

- To investigate the nature and extent of learner migration from Mathematics to Mathematical Literacy.
- To examine the causes of migration of learners from Mathematics to Mathematical Literacy.
- To offer recommendations to help manage the problem of migration of learners from Mathematics to Mathematical Literacy.

1.5 RESEARCH METHODOLOGY

The problem was investigated by means of a literature study and an empirical inquiry.

1.5.1 Literature Study

A thorough review of the relevant literature concerned with Mathematics and Mathematical Literacy at schools and related educational settings was undertaken as preliminary steps in the

research. Primary and Secondary sources were consulted to identify critical issues in the past research and to establish current thinking on the subject of learner migration particularly at Grade 10-11. Such a review provided some insights into different perspectives on the subject and present a framework for further exploration as well as a basis for identification of variables to be included in the study.

1.5.2 Empirical enquiry

This study used a concurrent embedded mixed method design, which is a procedure for collecting, analyzing and 'mixing' both quantitative and qualitative data at some stage of the research process within a single study (Creswell, 2009: 214) and to understand a research problem more completely. The rationale for mixing is that neither quantitative nor qualitative methods are sufficient by themselves to capture the trends and details of a situation, but when used in combination, quantitative and qualitative methods complement each other and allow for more complete analysis (Creswell, 2002: 40).

The qualitative approach was dominant (QUAL + Quan) and the quantitative approach was subordinate. The reason is that the problem of concern lends itself more to a qualitative enquiry. The qualitative approach was used to collect textual data through semi-structured interviews and journal writings to help explain in more depth why learners migrate from Mathematics to Mathematical Literacy, in other words why they choose Mathematical Literacy over Mathematics.

In the quantitative approach, numeric data were collected using a questionnaire and the data were subjected to descriptive statistical analysis. The goal of the quantitative was to explore the frequency of causes that influence learners to choose Mathematical Literacy over Mathematics.

1.5.2.1 Selection of Participants

A population is a set of all elements; the large group to which a researcher wants to generalize his or her sample results (Johnson, Onwuegbuzie & Turner, 2008: 224). In other words, it is the total group that you are interested in learning more about. This study was conducted at three selected schools of Rekopantswe Area Office in Mahikeng. These three schools have a total number of 950 learners and 33 teachers including the SMTs; therefore the desired sample was selected by means of random sampling and purposeful sampling. Johnson *et al.,* (2008: 223) define a sample as a set of elements taken from a larger population according to certain rules. The target population in this study were the learners, who are admitted to the schools doing Mathematics and Mathematical Literacy, teachers of Mathematics and Mathematical Literacy and SMTs. Criteria for selecting the participants is discussed more in chapter three.

Three participants from each selected school, head of department in Mathematics were purposefully selected for interview and six learner participants were selected for journal writing. Randomly 100 learners were selected for the filling of the questionnaire but only 93 learners returned them back.

1.5.2.2 Data Collection Methods

In qualitative approach data were collected by means of a semi-structured interview and journal writing. An interview is a data collection method in which an interviewer asks questions of an interviewee (Johnson *et al.,* 2008: 203). This method was used because: It serves as the principal means of gathering information having direct bearing on the research objectives. In this study, the SMTs (head of department of Mathematics) were interviewed to collect

information about the learners' migration from Mathematics to Mathematical Literacy. The interviews with the participants were recorded in audio tapes.

Journal writing was used as a data collection instrument. Through journal writing, learners are encouraged to think freely in writing in their own words. In this study learners were asked to write about why they chose to do Mathematical Literacy over Mathematics in their own words. Learners were given an exercise book to record their thoughts.

In the quantitative approach data sets were collected by means of a structured closed-ended and open-ended questionnaire. A questionnaire is a self-report data-collection instrument that each research participant fills out as part of a research study (Johnson *et al.,* 2008: 170). The questionnaire was used in this study to gather information on the views of the Mathematics teachers and learners about the migration of learners from Mathematics to Mathematical Literacy as well as the choosing of the subject in Grade 10. Questionnaires were given to Mathematics and Mathematical Literacy teachers and learners.

1.5.2.3 Data Analysis

In qualitative studies, data collection and analysis proceed simultaneously. In the qualitative, the text data obtained through the interviews and documents was coded and analyzed for themes. The theoretical framework of constructivist learning theory has helped the researcher to understand the data very well and be able to analyse it with the correct models. According to Chacko (2004:10), "Constructivism" is a theory of learning which offers an explanation for how human beings learn. The researcher constructed her own new understandings or knowledge through the interaction between what she already knew and believed and ideas with which she come in contact with. Inductive and typological models were used in data analysis. Inductive model of data analysis allows the researcher to identify themes that emerged from

the data. In inductive model, themes emerged from the data not from predetermined categories. In typological model, themes or categories are predetermined. Typological analysis involves dividing the data into categories or groups. In the quantitative, data were analyzed by means of descriptive statistics. The results were summarized and displayed in graphs and tables. Frequency analysis was conducted to identify valid percentages for responses to all the questions in the questionnaire.

1.6 CONTRIBUTION OF THE STUDY

The main contribution of this study is its identification of the reasons why learners migrate from Mathematics to Mathematical Literacy. It is hoped that understanding the reasons would facilitate the implementation of strategies to manage the diversion of learners from Mathematics to Mathematical Literacy.

1.7 DELIMITATIONS AND LIMITATIONS

1.7.1 Delimitations

This study is delimited to three high schools in the Rekopantswe Area Office and to teachers teaching either Mathematics or Mathematical Literacy. It includes learners doing Mathematical Literacy or Mathematics in Grade 10-12 and those who have migrated from Mathematics to Mathematical Literacy between Grade 10 and 12.

1.7.2 Limitation

This study involved a small sample of teachers, learners and schools, hence the results cannot be generalised to the larger population of teachers, learners and schools. From the 69 questionnaires for Mathematical Literacy learners only 45 were filled correctly and 24 were

not usable, hence again that is why the results cannot be generalised. However, combining quantitative and qualitative data will provide useful information about the causes of learner migration from Mathematics to Mathematical Literacy in high schools.

1.8 DEFINITION OF TERMS

Mathematics is a human activity that involves observing, representing and investigating patterns and quantitative relationships in physical and social phenomena and between mathematical objects themselves. Through this process, new mathematical ideas and insights are developed (DoE, 2003).

Mathematical Literacy provides learners with the awareness and understanding of the role that Mathematics plays in the modern world, it is a subject driven by life-related application of Mathematics. It enables learners to develop the ability and confidence to think numerically and spatially in order to interpret and critically analyze everyday situations and to solve problems (DoE, 2003).

Migration is when a large number of people go to live in another area or country (Oxford Dictionary, 2005:1105). In this study migration is defined as learners changing from one subject to another (i.e from Mathematics to Mathematical Literacy).

1.9 CHAPTER OUTLINE

Chapter One comprises the introduction and background; statement of the problem; research questions or hypothesis; aims and sub-aims of the study; delimitations; limitations and definition of terms.

Chapter Two presents the literature reviewed in relation to the study and gives in depth knowledge about the area of the study.

Chapter Three represents the research design and methodology, population and sampling techniques, research methods and research instruments. Issues of credibility, validity, reliability and ethical consideration are discussed.

Chapter Four presents data analysis and interpretation of qualitative and quantitative data. Data were presented separately as per qualitative and quantitative approach.

Chapter Five presents a detailed discussion and synthesis of findings from qualitative and quantitative data, as well as conclusions and recommendations.

1.10 SUMMARY

Chapter One presented the introduction and background; statement of the problem; research questions; aims and sub-aims of the study; research design and methodology; delimitations; limitations and definition of terms. The next chapter presents the literature review in the field of Mathematics and Mathematical Literacy that informed this study.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

The first chapter presented the introduction and background, statement of the problem, research questions, aims and sub-aims of the study, delimitations, limitations and definition of terms. This chapter now presents the research literature in the field of Mathematics and Mathematical Literacy that informed this study. The chapter is divided into the following subsections: theoretical framework: constructivist learning theory; rationale: Mathematics and mathematical sciences as domains of knowledge; the nature of Mathematics and Mathematical Literacy; Mathematics versus Mathematical Literacy in matric 2011; purpose of Mathematics and Mathematical Literacy; educational and career links of Mathematics and Mathematical Literacy; South Africa's Mathematics and Science challenge; subject choice in grade 9; report on ANA results 2011; the purpose of the annual national assessments programme; international perspective on Mathematical Literacy; studies measuring learners' Mathematical Literacy skills; PISA: an overview of Mathematical Literacy; summary.

2.2 THEORETICAL FRAMEWORK: CONSTRUCTIVIST LEARNING THEORY

The DoE (2003: 43) explains a theoretical framework as something that:

> Provides the lens to view a phenomenon under study. The way people respond or make their arguments or view reality, is informed, explicitly or implicitly, by their epistemological or philosophical positions. The new curriculum in South Africa puts the learner and his/her experiences at the centre of the learning process. There is a

> constructivist perspective underpinning this way of viewing learning in the new curriculum (DoE, 2003: 43).

Johnson (2008: 55) explains "Constructivism", as:

> a perspective in education that explains how knowledge is constructed in the human being when new information comes into contact with existing knowledge that had been developed by experiences. It has its roots in cognitive psychology and biology and an approach to that lays emphasis on the ways knowledge is created in order to adapt to the world. Constructs are the different types of filters we choose to place over our realities to change our reality from chaos to order.

Meyer (2009: 65) describes Constructivism as "a theory of knowledge with roots in philosophy, psychology, and cybernetics". Constructivism has implications for the theory of instruction. Discovery, hands-on, experiential, collaborative, project-based and task-based learning are a number of applications that base teaching and learning on Constructivism. I view Constructivism as a basic theory which is based on observation and scientific study about how people learn. It says that people construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. When we encounter something new, we have to reconcile it with our previous ideas and experience, maybe changing what we believe, or maybe discarding the new information as irrelevant. We are active creators of our own knowledge.

Kim (2005:10) says that:

> The purpose in education is to become creative and innovative through analysis, conceptualizations, and synthesis of prior experience to create new knowledge. The educator's role is to mentor the learner during problem solving of ill-defined problems by enabling quested learning that may modify existing knowledge and allow for

creation of new knowledge. The learning goal is the highest order of learning: heuristic problem solving, metacognitive knowledge, creativity, and originality.

According to Chacko (2004:10), "Constructivism" is a theory of learning which offers an explanation for how human beings learn. Liljedahl (2007: 106) asserts that in Constructivism individuals construct their own new understandings or knowledge through the interaction between what they already know and believe and ideas, events, and activities with which they come in contact. Liljedahl (2007: 107) defines Constructivism as a theory of knowledge and contends that a constructivist view involves two principles, namely, active construction of knowledge by a learner and coming to know as a process of adaptation based on and constantly modified by the learner's experience of the world. He/she maintains that Constructivism is more than a theory of learning. He argues that children construct their knowledge of Mathematics over a period of time in their own, unique ways, building on their pre-existing knowledge. This view is supported by Chacko (2004: 10), who maintains that the idea of social learning is based on Constructivism. He argue that students in Constructivist classrooms get rich opportunities for understanding and creating Mathematics and to determine its validity.

According to Billett (1996), the theory of constructivism rest on the notion that there is an innate human drive to make sense of the world. Instead of absorbing or passively receiving objective knowledge that is "out there," learners actively construct knowledge by integrating new information and experiences into what they have previously come to understand, revising and reinterpreting old knowledge in order to reconcile it with the new.

Learners opt for Mathematical Literacy because of their previous experience in Mathematics. That is, if one struggles with Mathematics in Grade 9, when the time comes to choose between Mathematics and Mathematical Literacy it is quite obvious that one will choose Mathematical

Literacy. The next paragraph looks into the rationale: Mathematics and the Mathematical Sciences as domains of knowledge.

2.3 RATIONALE: MATHEMATICS AND THE MATHEMATICAL SCIENCES AS DOMAINS OF KNOWLEDGE

Mathematics is very important. It is the foundation of almost all Science and Commerce, career fields that one needs to undertake at university. It provides individuals with numerical and spatial skills that are needed in order to make informed decisions. The Department of Education saw the need for Mathematics since many learners were obtaining their matric certificate without Mathematics. They then decided to introduce Mathematical Literacy as a substitute for Mathematics in order to make South African learners to be mathematically informed/ inclined.

The DoE (2005:15) states that:

> Mathematical Literacy, Mathematics and the Mathematical Sciences as domains of knowledge are significant cultural achievements of humanity. They both have utilitarian and intrinsic value. All people have a right to access these domains and their benefits. These domains provide powerful numeric, spatial, temporal, symbolic, communicative and other conceptual tools, skills knowledge, attitudes and values to: analyze, make and justify critical decisions, and take transformative action, thereby empowering people to: work towards the reconstruction and development of South African society, develop equal opportunities and choice, contribute towards the widest development of the society's cultures, participate in their communities and in the South African society as a whole in a democratic, non-racist and non-sexiest manner, act responsibly in protecting the total environment, interest in a rapidly-changing technological global context, derive pleasure and satisfaction through the pursuit of rigour, elegance and the analysis of patterns and relationships, understand the contested

nature of mathematical knowledge, and engage with political organization systems and socio-economic relations.

The next paragraph provides insight into the nature of Mathematics and Mathematical Literacy.

2.4 THE NATURE OF MATHEMATICS AND MATHEMATICAL LITERACY

First, it is necessary to clarify our understanding of the term "Mathematics". The Oxford Dictionary defines Mathematics as a "Science of numbers and shapes or the process of calculating using numbers" (2005: 1125). Mathematics is the construction of knowledge that deals with qualitative and quantitative relationships of space and time. It is a human activity that deals with patterns, problems solving, logical thinking, etc., in the attempt to understand the world and make use of that understanding. However, in providing a meaning for Mathematics we need to understand it in the context of learning.

In South Africa, Mathematics and Mathematical Literacy relate to each other, but differ in terms of their nature and aims as well as content. In particular, Mathematics "enables creative and logical reasoning about problems in Mathematics itself", which 'leads to theories of abstract relations' (Department of Education, 2003c: 9). On the other hand, Mathematical Literacy equips and sensitises learners with an understanding of the relevance of Mathematics in real-life situations (Department of Education, 2003b: 9). Its purpose is to apply Mathematics to make sense of the world. Mathematical Literacy was specifically introduced as an intervention to improve numeracy skills of South African citizens in response to poor performance in Mathematics in the past (Bansilal, Mkhwanazi & Mahlabela, 2012:50).

Learners who can think in terms of 'symbolic representation or abstract conceptualization thinking about, analyzing, or systematically planning' and in terms of the concrete reality, including mathematical modelling and more applied Mathematics, should achieve in

Mathematics, whereas learners who can only think 'through experiencing the concrete, tangible, felt qualities of the world, relying on our senses and immersing ourselves in concrete reality', and not in terms of abstraction, should achieve in Mathematical Literacy (Kolb, Boyatzis & Mainemelis, 1999: 3). Moreover, the Grade 10–12 Mathematics syllabus, as set out in the National Curriculum Statement (Department of Education, 2003c: 10), is a purely academic subject which focuses more on content that the learners have to deal with, memorise and reflect on, as opposed to Mathematical Literacy which is a practical subject where learners learn practical skills that will enable them to find concrete solutions to numeric, spatial and statistical problems associated with the everyday challenges of life. In Mathematics attention has to be paid to specific details and, as Bohlmann and Pretorius (2008: 43) claim that the conceptual complexity and problem-solving nature of Mathematics make extensive demands on the reasoning, interpretive and strategic skills of learners. Mathematics is an abstract, deductive discipline that is required in the scientific, technological and engineering world.

According to Venkat (2007: 77), emphasis is laid on abstract rather than concrete concepts, on intra-mathematical connections rather than Mathematics-real-world connections, on rigour and logic rather than interpretation and critique, and on knowledge itself, as well as applications of knowledge.

In comparison to Mathematics, which is more abstract in nature, most definitions of Mathematical Literacy focus on the concrete dimension of Mathematics with the context determining the content to be learned. Learners use real-life situations to gain new knowledge; thus, a learner who tends to process information in a concrete way should achieve well in Mathematical Literacy. Gal (2009: 76) pointed out that Mathematical Literacy focuses on the relevance of learned knowledge to everyday life and links it to diverse real-world contexts, whilst Frith and Prince (2006: 67) state that people are mathematically literate if they have the

ability to express quantitative information in a verbal and visual form. Mathematical Literacy creates a consciousness about the role of Mathematics in the modern world and is therefore driven by practical applications. The subject develops the ability and confidence of learners to think numerically in order to interpret daily situations (Department of Education, 2003b: 8).

According to Zhang (2002: 179), students who reasoned at a higher cognitive developmental level tended to use a wider range of thinking styles than students who reasoned at a lower cognitive developmental level. Therefore, learners taking Mathematics, which focuses on "creative and logical reasoning" (Department of Education, 2003c: 9), are likely to utilise different styles of thinking when reasoning than learners taking Mathematical Literacy. Ideally, Mathematical Literacy learners should be able to reason by communicating, either verbally or in written form, because Mathematical Literacy uses everyday language for 'practical relevance and applications', which may be easier for learners to understand, whereas Mathematics uses highly technical mathematical language for "further math learning" (Graven & Venkat, 2007: 69). In particular, Venkat, Graven, Lampen, Nalube and Chitera (2009: 48) note that Mathematical Literacy promotes thinking as communication which consists of acts such as asking questions, hypothesizing, finding counter-arguments and drawing conditional conclusions within a situation. In contrast, Mathematics learners should use higher levels of visual-spatial reasoning and abstract thinking. Hence, to achieve in Mathematics, the use of symbols and notations, and mental processes that enhance logical and critical thinking, accuracy and problem solving, and 'mathematical problem solving (Department of Basic Education [DBE], 2011b: 8) should be emphasised as the content is in an abstract and generalisable form.

Mathematics deals with concepts as ideas or abstractions which learners have to bring together to solve a mathematical problem to enable them "to understand the world" (Department of

Basic Education, 2011b: 8). In contrast, Mathematical Literacy deals with 'making sense of real-life contexts and scenarios and mathematical content should not be taught in the absence of context (Department of Basic Education, 2011a: 8). The next paragraph provide information on Mathematics versus Mathematical Literacy in matric 2011.

2.5 MATHEMATICS VERSUS MATHEMATICAL LITERACY IN MATRIC 2011

According to the Department of Basic Education (DBE, 2011), not only did fewer candidates write pure Mathematics, but only marginally more than 46% passed the Mathematics exam with a score of more than 30%. Of the 275 380 candidates who wrote Mathematical Literacy, 86% passed with more than 30%. These results should not, however, come as a complete surprise – the Annual National Assessment of learner performance at Grades 3 and 6 carried out in 2011, showed that the national average performance in numeracy for Grade 3 was only 28%. At Grade 6, the national average performance in Mathematics was 30%. The various comments and analyses of the matric results have all pointed to the dismal figures of the Mathematics pass rate. Many argue, and rightly so, that this does not bode well for South Africa in its quest to produce more doctors, engineers and technicians.

Some have also argued that there is a trend towards pushing learners to take 'easier subjects' (which means no pure Mathematics or Physical Sciences) so that the pass rate of the school is not negatively affected. While the focus is on those who did not pass pure Mathematics, or just about passed it, not much is being said about those who opted to do Mathematical Literacy. It is a fact that not everyone is particularly good at Mathematics – it takes the right aptitude and a very good teacher to get across the very abstract and technical nature of pure Mathematics.

For many learners with inadequately trained Mathematics teachers (or in some cases no teachers) and the lack of mother-tongue teaching, Mathematic Literacy might be the only chance they have of acquiring any mathematical skills at all. In any event, there is no reason to assume that all learners want to enter fields for which a matric pass in pure Mathematics is necessary; this being so, perhaps Mathematic Literacy is a more practical option, and one which deserves to be promoted (Department of Basic Education, 2011). According to the DBE (2011):

> the proposal by the National Planning Commission that the university Mathematics and Science entrants should be increased to 450 000 by 2030 seems highly ambitious if one considers the 2011 Mathematics and Physical Science results. Only 67 541 candidates passed Mathematics with 40% or more; 61 109 passed Physical Science with 40% 9 or more which means that only 128 650 candidates could potentially be eligible to pursue a university degree within the Mathematics or Physical Science faculties.

The next section take us through the purpose of Mathematics and Mathematical Literacy.

2.6 PURPOSE OF MATHEMATICS AND MATHEMATICAL LITERACY

In an ever-changing society, it is essential that all learners passing through the Further Education and Training band acquire a functioning knowledge of the Mathematics that empowers them to make sense of society (Department of Education, 2003: 20). A suitable range of mathematical process skills and knowledge enables an appreciation of the discipline itself. It also ensures access to an extended study of the mathematical sciences and a variety of career paths. The study of Mathematics contributes to personal development through a deeper understanding and successful application of its knowledge and skills, while maintaining appropriate values and attitudes. Mathematics is a discipline in its own right and pursues the establishment of knowledge without necessarily requiring applications in real life.

Competence in mathematical process skills such as investigating, generalizing and proving is more important than the acquisition of content knowledge for its own sake. Mathematical competence provides access to rewarding activity and contributes to personal, social, scientific and economic development. It is understandable, therefore, that a variety of stakeholders in society exert demands on school Mathematics. These stakeholders include parents, learners, educators, Mathematics educators, employers, professional mathematicians, tertiary institutions, and cultural and political organizations (Department of Education, 2003: 23).

An important purpose of Mathematics in the Further Education and Training band is the establishment of proper connections between Mathematics as a discipline and the application of Mathematics in real-world contexts. Mathematical modelling provides learners with the means to analyse and describe their world mathematically, and so allows learners to deepen their understanding of Mathematics while adding to their mathematical tools for solving real-world problems. Mathematics can be used in a wide variety of physical, social and management Sciences. An appreciation of the manner in which Mathematics has developed over time establishes its origins in culture and the needs of society (Department of Education, 2003: 26).

South Africa has come from a past in which poor quality or lack of education resulted in very low levels of literacy and numeracy in our adult population. International studies have shown that South African learners fare very poorly in Mathematical Literacy tests when compared to counterparts in other developed and developing countries (Department of Education, 2005: 15). Learners who could not do well mathematically in General Education and Training usually stopped studying Mathematics, thus, contributing to a perpetuation of high levels of in numeracy. The inclusion of Mathematical Literacy as a fundamental subject in the Further Education and Training curriculum will ensure that our citizens of the future are highly numerate consumers of Mathematics. In the teaching and learning of Mathematical Literacy,

learners will be provided with opportunities to engage with real life problems in different contexts, and so to consolidate and extend basic mathematical skills. Thus, Mathematical Literacy will result in the ability to understand mathematical terminology and to make sense of numerical and spatial information communicated in tables, graphs, diagrams and texts (Department of Education, 2005: 18).

Furthermore, Mathematical Literacy will develop the use of basic mathematical skills in critically analysing situations and creatively solving everyday problems. In everyday life a person is continually faced with mathematical demands which the adolescent and adult should be in a position to handle with confidence. These demands frequently relate to financial issues such as hire-purchase, mortgage bonds and investments (Department of Education, 2005: 21). There are others, however, such as the ability to read a map, follow timetables, estimate and calculate areas and volumes, and understand house plans and sewing patterns. Situations, such as in cooking and the use of medicine, requiring the efficient use of ratio and proportion are encountered on a daily basis.

Here, Mathematical Literacy is required by a self-managing person. The workplace requires the use of fundamental numerical and spatial skills in order to efficiently meet the demands of the job. To benefit from specialized training for the workplace, a flexible understanding of mathematical principles is often necessary (Department of Education, 2005: 22). This numeracy must enable the person to, for example, deal with work-related formulae, read statistical charts, deal with schedules and understand instructions involving numerical components. Such numeracy will enable the person to be a contributing worker.

To be a participating citizen in a developing democracy, it is essential that the adolescent and adult have acquired a critical stance with regard to mathematical arguments presented in the

media and other platforms. The concerned citizen needs to be aware that statistics can often be used to support opposing arguments, for example, for or against the use of an ecologically sensitive stretch of land for mining purposes. In the information age, the power of numbers and mathematical ways of thinking often shape policy. Unless citizens appreciate this, they will not be in a position to use their vote appropriately. The Further Education and Training subject, Mathematical Literacy, should enable the learner to become a self-managing person, a contributing worker and a participating citizen in a developing democracy (Department of Education, 2005: 23). The next paragraph will look into the educational and career links of Mathematics and Mathematical Literacy.

2.7 EDUCATIONAL AND CAREER LINKS OF MATHEMATICS AND MATHEMATICAL LITERACY

Mathematics is an essential element in the curriculum of any learner who intends to pursue a career in the physical, mathematical, computer, life, earth, space and environmental sciences or in technology. Mathematics also has an important role in the economic, management and social sciences. It is an important tool for creating, exploring and expressing theoretical and applied aspects of the sciences. Mathematics is also important for the personal development of any learner (Department of Education, 2005: 16). The learning achieved in Mathematics in the General Education and Training band provides an essential base from which to proceed into the demands of Mathematics in the Further Education and Training band. The essentials of numeracy developed in the General Education and Training band are taken further, working in more symbolic ways.

How Mathematics can contribute to an understanding of financial issues is taken beyond dealing with budgets. The emphasis on contexts and integration within Mathematics and across the curriculum is maintained, while mathematical modelling becomes more prominent. The

subject Mathematics in the Further Education and Training band provide a platform for linkages to Mathematics in Higher Education institutions. It also provides for linkages to Mathematics of a complementary nature but specific to the needs of the individual, in appropriate Further Education and Training sites of learning (Department of Education, 2005: 16).

Learners proceeding to institutions of Higher Education should be mathematically literate, so that they are able to progress effectively in whatever discipline they decide to follow. Mathematics is being used increasingly as a tool for solving problems related to modern society. The financial aspects of dealing with daily life are informed by mathematical considerations. Mathematical ways of thinking are often evident in the workplace. The Learning Outcomes and Assessment Standards in Mathematics are designed to allow all learners passing through this band to develop into citizens who are able to deal with the Mathematics that impinges on the society they live in and on their daily lives. If a learner does not perceive Mathematics to be necessary for the career path or study direction chosen, the learner will be required to take Mathematical Literacy.

The learning achieved in Mathematics in the General Education and Training band provides a base from which to proceed to the demands of Mathematical Literacy in the Further Education and Training band. The essentials of numeracy are taken further by working in contexts which become increasingly relevant. The engagement with space and shape becomes more practical. The methods and uses of statistics and chance are dealt with in greater depth (Department of Education, 2005: 23). Learners have to deal with more complex financial issues which directly affect their lives. The Learning Outcomes of Mathematical Literacy are designed to enable learners passing through the Further Education and Training band to handle with confidence the Mathematics that affects their lives and so be appropriately educated for the modern world.

They will be able to proceed with learnerships in career pathways that require Mathematical Literacy at the relevant National Qualifications Framework (NQF) levels. Students proceeding to Higher Education institutions will have acquired a Mathematical Literacy that will enable them to deal effectively with mathematically-related requirements in disciplines such as the Social and Life Sciences. Mathematical Literacy should not be taken by those learners who intend to study disciplines which are mathematically based, such as the Natural Sciences or Engineering (Department of Education, 2005: 24).

2.8 SOUTH AFRICA'S MATHEMATICS AND SCIENCE CHALLENGE

Brian O'Connell in the National Business Initiative's report 2009 states that:

> South Africa's education system is facing a major challenge in increasing its output of matriculants with university-entrance Mathematics and Physical Science passes. While the country has seen spectacular growth in secondary school enrolment since 1994, the focus is moving to strengthening the quality of education and increasing in the number of matriculants who have strong foundations in Mathematics and Science. Since 1994 South Africa has achieved almost 100% enrolment in primary and secondary schooling, with the participation rate among girls being among the highest in the world. Although participation in Grades 11 and 12 drops by 10-15%, Grade 12 participation rates are growing at between 20 000 and 30 000 learners each year. This compares favourably with secondary school participation in China at 89% on average and in India at 49%. Figures for secondary school enrolment in Africa are even lower: 45% in Northern Africa, 25% in South-Eastern Africa and 13% in Central Africa.

The matriculation pass rate increased from 58% in 1994 to 65% in 2007, but at both secondary and primary level the country's performance in Mathematics and Science lags way behind that of other countries, many of which are much poorer than South Africa. In 2003 South African learners scored lowest in the Trends in International Mathematics and Science Study (TIMSS),

while in 2007 only 15% of Grade 3 learners achieved the required numeracy and literacy levels in the National Systemic Evaluation. The DBSA roadmap process indicates that approximately one out of every 40 children that started school in 1995 passed matric Mathematics at Higher Grade level and that 93% of maths passes came from 21% of schools.

Penny Vinjevold, Deputy Director-General for FET in the national Department of Education, points out that:

> To some extent rapid growth in school enrolment has occurred at the expense of quality in education, which is now the department's key focus. Clearly, poor Mathematics and Science results affect the availability of key skills required in the economy, such as engineering, and these and other skills shortages constitute a significant constraint on growth and employment creation. In addressing the challenges faced by South Africa in Mathematics and Science the Department of Education established the Dinaledi School Project (Penny Vinjevold in the National Business Initiative's report 2009).

2.8.1 What is the Dinaledi schools initiative?

In 2001 the Department of Education established the Dinaledi School Project to increase the number of matriculants with university-entrance Mathematics and Science passes. The strategy involves selecting certain secondary schools for Dinaledi status that have demonstrated their potential for increasing learner participation and performance in Mathematics and Science, and providing them with the resources and support to improve the teaching and learning of these subjects. The Dinaledi School Project will be expanded to other schools in the long term. The programme started with 102 schools in 2002-2004 and by 2008 this number had increased to a total (capped) of 500 (8% of secondary schools). Over the years, a number of under-performing schools were removed from the project.

Table 2.1 shows that 77 of the original 102 schools were retained when the project was expanded to 400 schools in 2006. Similarly, in 2007, 371 of the 400 schools were retained when the number of Dinaledi schools grew to 488 (Department of Education 2009 in the National Business Initiative's report).

Table 2.1 Number of Dinaledi schools by province and year intervals

Province	Number of schools			
	2002-2004	2006	2007	2008
Eastern Cape	15	60	60	60
Free State	6	30	35	36
Gauteng	11	70	101	101
KwaZulu-Natal	23	70	84	88
Limpopo	23	50	51	51
Mpumalanga	7	30	44	46
North-West	7	40	51	53
Northern Cape	4	10	17	17
Western Cape	6	40	45	48
TOTAL	102	400(77)	488(371)	500(478)

Source: Department of Education 2009 in the National Business Initiative's report.

2.8.2 Which schools qualify for the project?

According to Brian O'Connell in the National Business Initiative's report, 2009:

Initially, the programme focused on improving the performance of African learners and former African schools rather than former white, coloured and Asian schools. The criterion for inclusion was that schools had to have achieved at least 35 Senior Certificate Mathematics passes by African candidates, either at Higher Grade or Standard Grade level. In Gauteng, the Western Cape and KwaZulu-Natal, some former white schools that meet this criterion are included in the Dinaledi programme. Dinaledi schools are intended to raise the participation and performance by historically disadvantaged learners in National Senior Certificate Maths and Physical Science. The Dinaledi project thus consists of 500 schools that serve black learners. They are not necessarily the best-performing schools, but have the potential to expand the provision of high-quality Mathematics and Science teaching and learning.

2.8.3 Support provided by the Department of Education to Dinaledi schools

According to Brian O'Connell in the National Business Initiative's report, 2009: The Department of Education has provided basic levels of support to Dinaledi schools to meet their greatest needs. The Department of Education is committed to ensuring that learners in Grades 10-12 each have textbooks for each of the seven subjects. In 2007 the department conducted a survey of Grade 12 textbook requirements in Dinaledi schools for the 2008 school year. With a grant from the Royal Netherlands government, it was able to supply English language, Mathematics, and Mathematical Literacy and Science textbooks to all Dinaledi schools that requested them for Grade 12.

However, severe shortages of textbooks persist in Grades 10 and 11, and in 2009 Dinaledi schools experiencing such textbook shortfalls will be prioritised for support, based on a survey of their textbook requirements. This is to ensure that learner preparation for Grade 12 is not hampered. In 2008 a 100-hour teacher training process was undertaken with 2 400 teachers in Dinaledi schools across all nine provinces to strengthen their content knowledge, improve their teaching of Mathematics and Science and improve learner performance.

The impact of the training is being assessed. In 2009, following reports from moderators of the 2008 Mathematics and Physical Science National Senior Certificate Examinations, further training will be made available to at least 500 teachers in each of Mathematics and Science on specific content areas. The training will take place in the June and September school holidays and will be decentralised in provinces. The training team will consist of members of the SA Mathematics Foundation (SAMF), higher education experts and subject advisors with demonstrated levels of subject competence. The impact of this training will be assessed through pre- and post-tests conducted at the start and conclusion of the training (The Dinaledi Schools Project Report June 2010). The next section will provide information on the subject choice in Grade 9

2.9 SUBJECT CHOICE IN GRADE 9

According to Pace careers web-site:

> A subject choice in Grade 9 is always a stressful time for learners as most learners (and parents) find it difficult to choose subjects for Grade 10. There are many questions, e.g., which subjects will keep the learner's options open for further study after school and if they should take Mathematics. With the introduction of the new curriculum, learners and parents need information about the new subject requirements and the entry requirements for tertiary study. The more a person knows the better informed they are, the more likely a person makes the best possible decision. In some cases there are regrets, not everyone can be 100% sure. However, we can certainly reduce the risks by researching the subjects and the options available.

Mathematics is the single most common source of subject choice heartache. Parents are in favour of their children taking Mathematics argue that Mathematics is an essential part of a well-rounded education. They argue keeping Mathematics until Grade 12 keeps a lot more career options open. Learners who struggle to do Mathematics at school find themselves

stressed with having to cope with a difficult subject. They argue that they do not like Mathematics and that in fact they will not be going to career fields that will require Mathematics anyway as well as arguing that it will lead to a lower average should they take Mathematics.

Those who have faced this dilemma will in the end ask themselves the perceived benefits of taking Mathematics outweigh the positively bad effect of stress. With the introduction of the new curriculum, the debate around whether to take Mathematics or not has been made a little easier with the introduction of Mathematical Literacy into the new curriculum. The question young people and parents will be asking themselves is not whether or not to take Mathematics in Grade 10. Rather, the question will be do we take Mathematics or Mathematical Literacy?

Mathematics Higher Grade and Standard Grade, as we knew it, was phased out in 2008. Then it was compulsory for a learner to take either Mathematics or Mathematical Literacy as one of their subjects until Grade 12. The next paragraph focuses on the report on annual national assessment results 2011.

2.10 REPORT ON ANNUAL NATIONAL ASSESSMENT (ANA) RESULTS 2011

Mrs Angelina Matsie Motshekga (Minister of basic education) stated that "the improvement of the quality and levels of educational outcomes in the schooling system is a top priority of both Government and the Department of Basic Education. The extent to which these outcomes are achieved will be monitored through the administration of the Annual National Assessment (ANA). The ANA written in February 2011 involving almost six million learners in primary schools throughout South Africa represents one of the most significant proactive interventions by Government to strengthen the foundational skills of Literacy and Numeracy among South African learners (Department of Basic Education, 2010). This important intervention forms

one of the key strategies that the Department has put into place to annually measure progress on learner achievement towards the 2014 target of 60% achievement rate articulated in the Action Plan to 2014: Towards the Realisation of Schooling 2025" (Department of Basic Education, 2010: 4).

ANA is expected to have four key effects on schools: to expose teachers to better assessment practices, make it easier for districts to identify schools in most need of assistance, encourage schools to celebrate outstanding performance and empower parents with important information about their children's performance. The ANA 2011 Report provides the first national baseline to benchmark annual targets and achievement towards realizing the desired 60% threshold of learners mastering the minimum Literacy and Numeracy competencies by the end of Grades 3, 6 and 9 respectively. The Report includes the results of learners in Grades 3 and 6 which were independently moderated by the Human Sciences Research Council (HSRC). From 2012 onwards, the results of Grade 9 learners will also be reported (Department of Basic Education, 2010: 4).

The release of the Report on ANA performance is also an opportunity to highlight: the positive impact of the Foundations for Learning Programme introduced in 2008 on learner achievement; the massive unprecedented intervention by Government in the development and distribution of quality learning and teaching support material through the Workbook programme; and other key deliverables already underway including the strengthening of the curriculum by introducing CAPS and improving infrastructural support with the help of ASIDI. It is critical that the ANA data be effectively utilized at all levels of the system to sustain Government's solid electoral mandate and the hopes and aspirations of all South Africans in the medium to long term and to demonstrate that measurable delivery is taking place in the basic education

sector (Department of Basic Education, 2010: 4). The next section will take us through the purpose of annual national assessment programme.

2.11 THE PURPOSE OF THE ANNUAL NATIONAL ASSESSMENTS PROGRAMME

The main purpose of the Annual National Assessments (ANA) programme is to make a decisive contribution towards better learning in schools. Four key areas of impact at the school and district levels have been identified (Department of Basic Education, 2010: 10).

2.11.1 (a) ANA should encourage teachers to assess learners using appropriate standards and methods.

This has been a focus of ANA since the trial runs of 2008 and 2009. Evidence indicates that ANA has indeed brought about better assessment practices in the classroom, by exposing teachers to well-constructed tests and marking memoranda but also by encouraging district offices and provincial departments to review their own initiatives aimed at supporting teachers in this area. For instance, in Eastern Cape newly developed 'common tests' in languages and Mathematics for Grades 3, 6 and 9 were conducted across the province in the middle and the end of the 2010 school year. Having ANA at the start of the school year provides teachers with an additional indication of where their own learners will require extra support during the course of the year.

2.11.2 (b) ANA should encourage better targeting of support to schools. District offices, which have been integrally involved in the 2008 and 2009 trial runs, have used ANA results to produce a better picture of what support to provide and to which schools. Before ANA, in most provinces there was no reliable way of knowing which schools performed better than others because assessments were not sufficiently standardized across schools. ANA will help to

ensure that schools receive the support they should receive and that schools are not obliged to participate in development activities which they have no need for. Moreover, ANA makes it easier for districts to identify which schools perform well and therefore which schools the district as a whole can learn from. The 2011 ANA data allow the Department of Basic Education (Department of Basic Education, 2010: 10) to assist districts and provinces in a more direct way in this area. Specifically, the 2011 data will be used to produce standard reports for districts that will encourage a more effective approach to the targeting of schools for support purposes.

2.11.3 (c) ANA should encourage the celebration of success in schools. By providing schools with a clearer picture of how well they perform in comparison to schools facing similar socio-economic challenges, schools that perform well will know when this is the case and schools which do not will have a clearer idea of what is possible and who they could learn from. Government does not support the use of ANA for the purposes of 'naming and shaming' those who do not perform well. At the same time, good performance should be recognized and lauded. ANA should become a key indicator in the school development plan and in fact in some districts ANA targets for future years are being negotiated between support personnel from district offices and schools.

2.11.4 (d) ANA should encourage greater parent involvement in improving the learning process. During 2011 some schools have used ANA as an opportunity to get parents more involved in academic improvement. Specifically, ANA can provide parents on the School Governing Body, as well as parents in general, with a better picture of the grades and subjects where special attention is needed. This can assist both efforts in the school and efforts in the home aimed at ensuring that learning occurs as it should. The collection of data from the ANA process, including marks, into a national database is an important aspect of ANA. This allows

the Department of Basic Education (DBE, 2010: 11) to analyze important patterns, for instance, how frequently schools perform poorly in both languages and Mathematics, as opposed to just one of these subjects, or how often learners within the same school provide the same incorrect responses to the same question, something which could point towards problems in the way teachers teach. National reports on these matters need to guide those working on teacher development, those developing workbooks and textbooks and those involved in providing management support to schools. Moreover, the national database allows for the generation of standard reports for provinces and districts which can inform the targeting of support to schools (DBE, 2010: 11). The next section will highlight on the international perspective on Mathematical Literacy.

2.12 INTERNATIONAL PERSPECTIVE ON MATHEMATICAL LITERACY

There are various international perspectives on Mathematical Literacy, but in this study only few international perspectives will be considered. According to Jablonka (2003: 77), there is an expanding literature that uses the terms

> "Mathematical Literacy" and "Numeracy" as synonyms. The National Council on Education and the Disciplines however uses the term "quantitative literacy" to stress the importance of enquiring into the meaning of numeracy in a society that keeps increasing the use of numbers and quantitative information. Jablonka prefers to use the term "Mathematical Literacy" to focus attention on its connection to Mathematics and being literate, in other words to a mathematically educated and well-informed individual.

In a comprehensive study by Jablonka (2003: 76), in which different international perspectives on Mathematical Literacy were investigated, she found that the perspectives basically differ according to the stakeholders' underlying principles and values. In her opinion, there is a direct

connection between a conception of Mathematical Literacy and a particular social practice. She acknowledges the difficulty of pointing out the distinct meaning of Mathematical Literacy as it varies according to the culture and context of the stakeholders who promote it. The different conceptions of Mathematical Literacy relate to a number of relationships and factors. One of the relationships is between Mathematics, the surrounding culture, and the curriculum (Jablonka, 2003: 97) while another is school Mathematics and out-of school Mathematics as Mathematical Literacy is about the individual's ability to use the Mathematics they are supposed to learn at school. Varying with respect to the culture and the context four possible perspectives of Mathematical Literacy are:

- The ability to use basic computational and geometrical skills in everyday contexts
- The knowledge and understanding of fundamental mathematical notions.
- The ability to develop sophisticated mathematical models; and
- The capacity for understanding and evaluating another's use of numbers and mathematical models ((Jablonka, 2003: 76).

2.13 STUDIES MEASURING LEARNERS' MATHEMATICAL LITERACY SKILLS

There are various studies measuring learners' mathematical knowledge and skills, but in this study only few international comparative studies will be considered, namely, Programme for International Student Assessment's (PISA), TIMSS as well as the study on the solution of real-world and standard problems by primary and secondary school students in Zimbabwe and one South African study will be mentioned.

Every three years PISA assesses 15-year-olds' reading, mathematical and scientific literacy in different countries. Its purpose is to measure how well students can apply their knowledge and

skills to problems within real-life contexts. PISA is designed to represent a yield of learning at age 15, rather than a direct measure of attained curriculum knowledge (National Centre for Education Statistics, 2008b: 3). In 2003, when 45 countries participated, the focus was on Mathematics. Every four years TIMSS assesses fourth and eighth Graders' Mathematics and Science performance in different countries (58 in 2007) to compare U.S. learners' performance with that of their peers in other countries. The two studies differ in focus as TIMSS seeks to find out how well students have mastered curriculum-based scientific and mathematical knowledge and skills whereby the purpose of PISA is to assess students' scientific and Mathematical Literacy, that is, their ability to apply scientific and mathematical concepts and thinking skills to everyday, non-school situations (Nohara, 2001: 11). In the next section attention is given to PISA's definition of Mathematical Literacy and the criteria used in assessing learners' Mathematical Literacy skills.

Chacko (2004:11) conducted a study on the solution of real-world and standard problems by primary and secondary school students in Zimbabwe. She aligned her study with Constructivism. She notes that in constructivist approaches, the learner is an active participant in the learning process, constructing knowledge through social interaction, negotiation and cooperation. Constructivist theory matches well with this study, as it embeds learning in realistic and relevant contexts (Liljedahl, 2007: 107). A constructivist perspective has been used in this study to examine teachers' views on the factors that influence migration of learners from Mathematics to Mathematical Literacy.

Two key aspects of Constructivism form the basis of analysis and interpretation of the findings:

i) Knowledge constructed by human mind as a result of previous experiences/prior knowledge.

ii) Knowledge constructed by human mind as a result of social interaction. Central to this study is the assumption that the way teachers view the role of contexts in Mathematical Literacy is bound to be shaped by their knowledge and experiences of Mathematical Literacy, in addition to the way they themselves understand what this subject means for themselves and for the learners in their classrooms.

This is the local study conducted by Spangenberg (2012). In his article he focuses on the characterisation of the thinking styles of Grade 10 Mathematics and Mathematical Literacy learners in eight schools in Gauteng West, South Africa. Since 2006, learners have had the choice to study either Mathematics or Mathematical Literacy in Grades 10–12 (DoE, 2003a).

A subject is defined as 'a specific body of academic knowledge' where 'knowledge integrates theory, skills and values' (DOE, 2003c: 6). Spangenberg refers to a subject as a particular area of study that schools offer, for example, Accounting, English, Mathematics or Mathematical Literacy.

Learners study Mathematics from Grade 4 to Grade 9; Mathematical Literacy is a new subject which can only be studied in Grade 10 to Grade 12. Initially, parents and teachers guide learners in their subject choices, based on factors such as future career, language, socio-economic background, interests and achievements in the lower Grades (Spangenberg, 2012). However, in the higher grades, learners' own thinking styles influence their preference for the different subjects (Borromeo Ferri, 2004: 30).

His research reveals that thinking styles play an important role in teaching and learning (Borromeo Ferri, 2004: 23; Cilliers & Sternberg, 2001: 70; Moutsios-Rentzos & Simpson,

2010: 80; Zhang, 2006: 20). He found that certain thinking styles correlated positively to a learner's success in a variety of academic tasks, whereas other thinking styles tended to correlate negatively to success in the same tasks. Van der Walt (2008: 34) also noted that a learner's thinking style is a factor that influences the effective learning and teaching of Mathematics and could predict achievement of Mathematics in school. Therefore, he argues that learners' thinking styles could affect their choice to study either Mathematics or Mathematical Literacy. By establishing which thinking style is associated with learners in each of the two subjects, one should be able to guide them, their parents and teachers in making more informed decisions with regard to the choice between Mathematics and Mathematical Literacy as a subject.

Spangenberg used the precepts of Sternberg's theory in order to characterise and compare the thinking styles of learners taking Mathematics and those taking Mathematical Literacy in South Africa. His article reports on part of a broader study that he had previously conducted on the placement of Grade 10 learners to provide advice for learners, parents and teachers in terms of choosing between Mathematics and Mathematical Literacy (Spangenberg, 2012).

The question arising from the above discussion is: Which thinking styles are associated with learners taking Mathematics and those taking Mathematical Literacy? Hence, Spangenberg conducted a literature inquiry with regard to the thinking styles and the nature of Mathematics and Mathematical Literacy.

Thinking Styles

A style is a particular procedure or manner by which something is done or a specific way or tendency unique to a person (Soanes, 2002:46). In particular, Zhang and Sternberg (2000: 469)

define a thinking style as 'a source of individual differences in academic performance that are related not to abilities but how people prefer to use their abilities'. Whereas a learning style refers to a way of approach to learning, a thinking style refers to a particular act, idea, tendency or way of thinking about the execution of a task in the learning process. Thus, a learning style is how a learner receives information, whilst a thinking style is how a learner processes information and reflects on ideas in their mind. For Cilliers and Sternberg (2001:14), thinking style is a 'preference' for using abilities in certain ways during processing.

Sternberg (2000: 368) noted that a teacher may not appreciate a learner's ability and may view him or her as 'slow' or 'behind' because of a difference in thinking style between the learner and the teacher. Conversely, Van der Walt (2008: 234) argued that learners' thinking styles may contribute to their inability to solve mathematical problems, even though they have the necessary knowledge. However, research conducted by Sternberg (2000: 379) has revealed that teaching and learning can improve if teachers give more attention to thinking styles. Both learners and teachers bring their own individual characteristics and thinking styles to the learning environment (Zhu, 2011:70). These thinking style preferences lead to learning style preferences and in turn determine learners' dominant cognitive modes, that is, the ways in which they communicate and receive information. More specifically, 'cognitive functions are accommodated when teaching activities are constructed to comply with a learner's preferred mode of thinking' (De Boer & Bothma, 2003: 1).

The aim of Spangeberg's study was to establish which thinking styles are associated with learners studying these subjects, so as to develop guidelines that will contribute to the subject choice of either Mathematics or Mathematical Literacy by Grade 10 learners, and eventually to better performance in the two subjects. It was found that there is a relationship between learners' thinking style dimensions and which subject they are studying. Mathematics learners

are more likely than Mathematical Literacy learners to execute instructions, to design and do things in their own way and to be critical. Where Mathematics learners are more likely to do many things at the same time and to set priorities pertaining to what to do, at what time to do it and how much time and energy to spend on it, Mathematical Literacy learners are more likely to do one thing at a time and spend almost all their energy and resources on it (Spangenberg, 2012).

This information about the thinking styles of learners could be used to help place learners more appropriately and possibly reduce the number of learners who make inappropriate choices. Also, this will ease pressure on teachers who have to deal with larger classes due to subject changes later during a year and may have to re-teach subject content. More learners will gain university exemption. In support, Borromeo Ferri (2004: 2) argued that thinking styles should 'not be viewed as being unchangeable, but they may change depending on time, environment and life demands'. In his conclusion:

> he said now that access to education and the right to learning have been established for most learners in South Africa, the time is ripe to set key priorities for the country's future. There is an urgent need to increase the number of learners with sufficient and well-established mathematical knowledge and skills, and so enable them to progress in the short, medium and long term to higher education, the business world and industry. There is a great demand for teachers in Mathematics and Mathematical Literacy to equip learners with the necessary knowledge and skills.

2.14 PISA: AN OVERVIEW OF MATHEMATICAL LITERACY

In this overview of Mathematical Literacy in South Africa the history and principles of the subject are discussed. An overview of the two subjects Mathematical Literacy and Mathematics is given, some general concerns about Mathematical Literacy are discussed and lastly a

comparison is made between the national and international perspectives on Mathematical Literacy.

2.14.1 The Mathematical Literacy curriculum reform

Curriculum 2005 was introduced in 1998, coinciding with the birth of a new democracy in South Africa's post-apartheid era, and was based on the principles of outcomes-based education (OBE) (Department of Education, 2006). This curriculum was revised in 2000 and in 2002 the NCS for the FET phase was developed. In 2009 a task term reviewed the curriculum documents and apart from problems related learning materials and teacher training, the curriculum documents were deemed to be in need of streamlining (Department of Education, 2009). The task team found that some of these documents contradicted each other while at other times there were repetitions. The review supports the DoE's current move away from OBE and learning outcomes, which are now replaced with clear content, concept and skill standards as well as clear and concise assessment requirements (Department of Education, 2009). The various subject specific documents will be replaced with a single document called the Curriculum and Assessment Policy Statement (CAPS) (Department of Education, 2009). The date of implementation is 2012 for Grade 10, 2013 for Grade 11 and 2014 for Grade 12.

2.14.2 Some general concerns about Mathematical Literacy

The Mathematical Literacy teachers

As Mathematical Literacy is a relatively new subject and different to Mathematics, clear guidelines from DoE regarding issues such as pedagogical approaches to teach Mathematical Literacy should have been given, but instead the absence of precedents of what pedagogy and assessment should be like (Graven & Venkat, 2007:67) caused multifarious interpretations of

the curriculum aims. Bowie and Frith (2006:30) were concerned about a perception that Mathematical Literacy could be interpreted as a slightly toned-down standard Grade Mathematics with word sums (Bowie & Frith, 2006:32). Experience and research have indicated that Mathematics learners and in many cases teachers too, find word or application problems requiring conceptual understanding more difficult than routine problems which require factual recall or the use of routine procedures (White & Mitchelmore, 2002: 47).

De Villiers (2007: 30) confirms that Mathematics learners cope well with the theory of linear functions but when it is put in real-life contexts they cannot solve such problems. Even in Mathematical Literacy both teachers and learners find the process of mathematizing contexts complex as a good understanding of both the context and the mathematical content is required (Bowie & Frith, 2006: 40). A further concern is the number of Mathematical Literacy teachers with other specializations who also teach the subject. It is known that in the past, before Mathematical Literacy was introduced, there existed a shortage of appropriately qualified Mathematics teachers and the question arises as to the provenance of all the teachers who now teach both Mathematical Literacy and Mathematics. Bowie and Frith (2006: 42) further suggested that a change is required not only in pedagogical content knowledge, but also in understanding the nature and value of Mathematical Literacy.

2.15 SUMMARY

Chapter 2 explored the international and national perspectives of Mathematical Literacy as well as Mathematics. Although the emphasis and terminology differ between countries, the researcher believes in the importance and value of learners' Mathematical Literacy skills that should be developed and enhanced. In South Africa, Mathematical Literacy refers to both a subject and a competency whereas in other countries it is mainly the latter. Mathematical

Literacy may have become stigmatized as a subject having virtually no meaning when it comes to career opportunities, but a closer investigation showed that this subject has its own demands and requires specialized positive belief system towards Mathematical Literacy as a specialized subject. The subject has its own disadvantage when it comes to job opportunities or career fields. The high number of learners enrolling for Mathematical Literacy in the country makes it difficult for universities enrolment in Science fields, Accounting, and so forth, since those fields require Mathematics as the core subject. The beliefs teachers hold regarding Mathematics as a discipline normally vary from traditional perspective to a formalist perspective through to a constructivist perspective. The following chapter will focus on the research design and methodology of the study.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

Chapter Three presents the research design and methodology that was used in this study. This study used a mixed method design which combines the quantitative and qualitative approaches. Qualitative data were collected first using interviews and journal writings, followed by the collection of quantitative data using a questionnaire. This chapter further describes the research methods, study population, sampling techniques and the instruments that were used to collect data.

3.2 RESEARCH DESIGN AND METHODOLOGY

This study used a concurrent embedded mixed method design (Creswell, 2009: 214), which is a procedure for collecting, analyzing and "mixing" both quantitative and qualitative data at some stage of the research process within a single study, to understand a research problem more completely. When used in combination, quantitative and qualitative methods complement each other and allow for more complete analysis (Creswell, 2002: 40).

In quantitative research, an investigator relies on numerical data (Charles & Mertler, 2002: 146). Researchers use Post-Positivist claims for developing knowledge, such as cause and effect thinking, reduction to specific variables, hypotheses and questions, use of measurement and observation, and the test of theories. A researcher isolates variables and causally relates them to determine the magnitude and frequency of relationships. In addition, a researcher himself/herself determines which variables to investigate and chooses instruments, which will yield highly reliable and valid scores. Alternatively, qualitative research is "an inquiry process

of understanding" where the researcher develops a "complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting" (Creswell, 2003:15). In this approach, the researcher makes knowledge claims based on the constructivist or advocacy/participatory perspectives (Mertens, 2003: 170). In qualitative research, data is collected from those immersed in everyday life of the setting in which the study is framed. Data analysis is based on the values that these participants perceive for their world. Ultimately, it produces an understanding of the problem based on multiple contextual factors (Miller, 2000: 124). In a concurrent mixed methods approach, researchers build knowledge on pragmatic grounds (Creswell, 2003: 144; Maxcy, 2003: 29) asserting truth is "what works".

According to Creswell (2002: 156) and Creswell *et al.* (2003: 45), "researchers select approaches, as well as variables and units of analysis, which are most appropriate for finding an answer to their research question. A major tenet of pragmatism is that quantitative and qualitative methods are compatible. Thus, both numerical and text data, collected sequentially or concurrently, can help better understand the research problem". A qualitative approach was used to collect text data through semi-structured interviews and journal writings. The goal of the qualitative phase was to identify what causes learners to choose Mathematical Literacy over Mathematics.

A quantitative approach was used to help explain why certain causes, that may be significant predictors of the learners' migration from Mathematics to Mathematical Literacy or learners' choosing Mathematical Literacy over Mathematics. The rationale for qualitative approach is that the quantitative data and results provide a general picture of the research problem, that is, what causes contribute to and/or impede learners' persistence in migrating from Mathematics to Mathematical Literacy, while the qualitative data and its analysis refine and explain those statistical results by exploring participants' views in more depth. The quantitative, numeric,

data were collected, using a questionnaire and the data were subjected to a descriptive statistics analysis.

3.2.1 Research Paradigm

According to Taylor, Kermode and Roberts (2007: 5), a paradigm is "a broad view or perspective of something". Additionally, Johnson *et al., 's* (2008: 170) definition of paradigm reveals how research could be affected and guided by a certain paradigm when they state that "paradigms are patterns of beliefs and practices that regulate inquiry within a discipline by providing lenses, frames and processes through which investigation is accomplished". This study utilised a triangulation approach to explore reasons why learners migrate from Mathematics to Mathematical Literacy in Grade 10-12. The use of both the qualitative and quantitative methodologies was necessary to encompass the different aspects of the problem under study. To address the diversity and complexity of the problem, a mixed methodology was necessary.

According to Creswell (2002: 157), the paradigms most commonly utilised in educational research are Positivist, Post-Positivist, Interpretive, and the Critical Social theory. The quantitative methodology shares its philosophical foundation with the positivist paradigm. The Positivist paradigm arose from the philosophy identified as logical positivism and is based on rigid rules of logic and measurement, truth, absolute principles and prediction (Miller, 2000: 126). The Positivist philosophy argues that there is one objective reality. Therefore, as a consequence, valid research is demonstrated only by the degree of proof that can be corresponded to the phenomena that study results stand for (Creswell, 2002: 1158). As a result, qualitative methodologies were also incorporated into the research design (see Table 3.1).

The qualitative methodology shares its philosophical foundation with the interpretive paradigm which supports the view that there are many truths and multiple realities. This type of paradigm focuses on the holistic perspective of the person and environment which is more congruent with the education discipline (Johnson *et al.*, 2008: 170). Additionally, the interpretive paradigm is associated more with methodological approaches that provide an opportunity for the voice, concerns and practices of research participants to be heard. Johnson further argues that qualitative researchers are "more concerned about uncovering knowledge about how people feel and think in the circumstances in which they find themselves, than making judgements about whether those thoughts and feelings are valid".

Table 3.1: Summary of the Research Paradigms as applied in the study

Characteristic	Positivist View	Interpretive View
Purpose	The researcher predicts and explains causes of migration of learners in Grade 10-12 participants	The researcher interviews HoDs and recognises the value and depth of the individual content
Beliefs	• One truth exists • Must be objective	• Many truths and realities • Different people have different perceptions, needs and experiences
Research Methods	Quantitative	Qualitative
What study data is based upon	Measurable outcomes from questionnaire data	Descriptive, explanatory and contextual words of interview data
Study Sample	Clear and precise inclusion and exclusion data	Representatives who are able to provide expert knowledge from different points of view.

Due to the complex nature of the research study, there was no single paradigm that could satisfactorily deal with all of the required methodological aspects. Therefore, the researcher found it necessary to combine the quantitative/positivist paradigm with the qualitative/interpretive paradigm. The blending of both paradigms provides the researcher with the ability to statistically analyse the scientific data whilst also recognizing the qualitative factors that cause the migration of learners from Mathematics to Mathematical Literacy in

Grade 10-12. The discussion that follows further elaborates and describes in detail how each paradigm and methodological approach was implemented in this study.

3.2.2 RESEARCH DESIGN: QUALITATIVE

Qualitative is a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem. The process of research involves emerging questions and procedures, data typically collected in the participant's setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data (Creswell, 2007: 4). Journal writings and interviews were used to collect data. Through journal writing, learners are encouraged to think freely in writing in their own words.

3.2.2.1 Site selection

This study was conducted in three high schools in the Rekopantswe Area Office at Mahikeng. The reason for choosing the Rekopantswe Area Office is because the researcher is working under that area office. The area office comprises of mostly village schools. Random sampling was used in selecting the schools whereby each school had an equal opportunity of being selected. The participants in each school were the SMTs, teachers and learners. These participants were helpful in this study since they are aware of the immediate problem of most learners migrating from Mathematics to Mathematical Literacy.

3.2.2.2 Researcher's role

The role of the researcher as the primary data collection instrument necessitates the identification of personal values, assumptions and biases at the outset of the study. The investigator's contribution to the research setting can be useful and positive rather than

detrimental (Creswell, 2003: 200). From 2010 to date I have been serving as a teacher. As a result of my previous experiences of working closely with learners and teachers from one of the selected schools, I brought certain biases to this study. Although every effort was made to ensure objectivity, these biases would shape the way I view and understand the data I collected and the way I interpret my experiences.

The researcher's involvement with data collection in this study is now described. In the qualitative study, the researcher personally conducted interviews and collected data using an audio recorder and also distributed exercise books for journal writing. The researcher assumed a more participatory role due to the "sustained and extensive experience with participants" (Creswell, 2003: 184). During data analysis the text data obtained through the interviews and journal writings were coded and analyzed for themes. The steps the researcher followed in analysis included: (1) preliminary exploration of the data by reading through the transcripts and writing memos; (2) coding the data by segmenting and labeling the text.

3.2.2.3 Participants Selection

This study was conducted at the three schools selected randomly. The actual names of the schools were not used for the sake of anonymity. A purposeful sampling strategy was used to select individuals for the study of the 'central phenomenon' (McMillan & Schumacher, 1994: 123), the causes of learner migration from Mathematics to Mathematical Literacy. Purposeful sampling involves purposefully selecting informants, who will best answer the research questions and who are information-rich persons. Three participants from the selected schools who were Heads of Department of Mathematics were purposefully selected for interview and six learner participants were selected for journal writing.

3.2.2.4 Data collection and recording

Data were collected by means of a semi-structured interview and journal writing.

3.2.2.4 (a) Interview as a data collection instrument

An interview is a data collection method in which an interviewer asks questions of an interviewee (Johnson *et al.,* 2008: 203). This method was used because

- it serves as the principal means of gathering information having direct bearing on the research objectives; and
- it was used in conjunction with the other methods in the research. In this instant, it was used with questionnaire and journal writings.

A semi-structured interview was used, as it was an open situation, having greater flexibility and freedom. In this study, the SMTs (Head of Department of Mathematics) were interviewed to collect information about the learners' choice of Mathematical Literacy over Mathematics. The interviews with the participants were recorded in audio tapes.

3.2.2.4 (b) Journal writing as a data collection instrument

Journal writing was used as a data collection instrument. Through journal writing, learners are encouraged to think freely in writing in their own words. In this study learners were asked to record their thoughts on a daily basis about their lessons and why they choose to do Mathematical Literacy over Mathematics in their own words or if they moved from Mathematics to Mathematical Literacy what was the reason. Learners were given an exercise book to draft their thoughts.

3.2.2.5 Data Analysis

In qualitative studies, data collection and analysis proceed simultaneously. The steps in qualitative analysis include: (1) preliminary exploration of the data by reading through the transcripts and writing memos; (2) coding the data by segmenting and labeling the text; (3) using codes to develop themes by aggregating similar codes together; (4) connecting and interrelating themes; and (5) constructing a narrative (Creswell, 2002: 45).

Data analysis is an ongoing and iterative process, that is, nonlinear process in qualitative research. Hatch (2002:153) presents five models of qualitative data analysis, namely typological, inductive, interpretive, political and polyvocal analysis. Inductive and typological models were used in data analysis. Inductive model of data analysis allows the researcher to identify themes that emerged from the data. In the inductive model, themes emerged from the data not from predetermined categories. In the typological model, themes or categories are predetermined. Typological analysis involves dividing the data into categories or groups. Typological data analysis according to Hatch (2002: 153):

> Starts by dividing the overall data set into categories or groups based on predetermined typologies. Having considered the instrument I was using for data collection, time frame and experience in data analysis, I regarded inductive and typological models for data analysis more convenient than other models.

3.2.2.5(a) Inductive model for data analysis

After the interviews with the HoDs were conducted and the journal writings collected, responses from the interviews were transcribed. The researcher noted common themes mentioned by the three HoDs and six learners. The transcripts were initially analysed by coding

segments of text common from the three transcripts for: HoD 1, HoD 2 and HoD 3 and from the journal notes for learner 1, learner 2, learner 3, learner 4, learner 5 and learner 6. After the analysis of the transcripts and notes four (4) themes were identified by the researcher, Mathematics vs Mathematical Literacy; migration; selection of Mathematics or Mathematical Literacy and; Mathematical Literacy can be easily passed compared to Mathematics.

3.2.2.5 (b) Typological model for data analysis

I had predetermined three categories for data analysis. These categories were predetermined as an attempt to address critical questions of this study.

Category 1: Nature and extent of learners' movement from Mathematics

This category covered all information that indicated the nature and extent of learners' movement from Mathematics to Mathematical Literacy.

Category 2: Causes of migration

This category covered all information that indicated the causes of migration of learners from Mathematics to Mathematical Literacy.

Category 3: What strategies may be devised to solve the problem of migration?

This category covered all information that indicated the solution in managing the problem of migration.

3.2.2.6 Measures of Trustworthiness

3.2.2.6 (a) Establishing Credibility

The criteria for judging a qualitative study differs from quantitative research. In qualitative design, the researcher seeks believability, based on coherence, insight, and instrumental utility and trustworthiness through a process of verification rather than through traditional validity and reliability measures. The uniqueness of the qualitative study within a specific context precludes its being exactly replicated in another context (Creswell, 2003: 50). To validate the findings, i. e., determine the credibility of the information and whether it matches reality, four primary forms were used in the qualitative phase of the study: (1) triangulation – converging different sources of information (interviews, journal writings); (2) member checking – getting the feedback from the participants on the accuracy of the identified categories and themes; (3) providing rich, thick description to convey the findings.

3.2.2.6 (b) Establishing Dependability

In addressing the issue of reliability, the positivist employs techniques to show that, if the work were repeated, in the same context, with the same methods and with the same participants, similar results would be obtained. Lincoln and Guba (2000: 120) stress the close ties between credibility and dependability, arguing that, in practice, a demonstration of the former goes some distance in ensuring the latter. This may be achieved through the use of "overlapping methods", such as the focus group and individual interview. In order to address the dependability issue more directly, the processes within this study were reported in detail, thereby enabling a future researcher to repeat the work, with or without similar results. Thus, the research design may be viewed as a "prototype model". Such in-depth coverage also allows the reader to assess the extent to which proper research practices have been followed. So as to enable readers of the

research report to develop a thorough understanding of the methods and their effectiveness, the text include sections devoted to:

a) *the research design and its implementation*, describing what is planned and executed on a strategic level; and

b) *the operational detail of data gathering*, addressing the minutiae of what was done in the field.

3.2.2.6 (c) Establishing Confirmability

Patton (2002: 36) associates objectivity in Science with the use of instruments that are not dependent on human skill and perception. He recognises, however, the difficulty of ensuring real objectivity, since, as even tests and questionnaires are designed by humans, the intrusion of the researcher's biases is inevitable. The concept of confirmability is the qualitative investigator's comparable concern to objectivity. Here steps must be taken to help ensure as far as possible that the work's findings are the result of the experiences and ideas of the informants, rather than the characteristics and preferences of the researcher. The role of triangulation in promoting such confirmability must again be emphasised, in this context to reduce the effect of investigator bias Miles and Huberman (1994: 96) consider that a key criterion for confirmability is the extent to which the researcher admits his or her own predispositions. The investigator's contribution to the research setting can be useful and positive rather than detrimental (Creswell, 2003: 200). From 2010 to date I have been serving as a teacher. As a result of my previous experiences of working closely with learners and teachers from one of the selected schools, I brought certain biases to this study. Although every effort was made to ensure objectivity, these biases would shape the way I view and understand the data I collected and the way I interpret my experiences.

This study used a concurrent embedded mixed method design (Creswell, 2009: 214) which is a procedure for collecting, analyzing and "mixing" both quantitative and qualitative data at some stage of the research process within a single study, to understand a research problem more completely. When used in combination, quantitative and qualitative methods complement each other and allow for more complete analysis. Once more, detailed methodological description enables the reader to determine how far the data and constructs emerging from it may be accepted. Critical to this process is the "audit trail", which allows any observer to trace the course of the research step-by-step via the decisions made and procedures described. One of the audit trail that was used in this study is the data-oriented approach, showing how the data eventually leading to the formation of recommendations was gathered and processed during the course of the study. In addition, the manner in which the concepts inherent in the research question gave rise to the work to follow may be tracked.

3.2.2.6 (d) Establishing Transferability

Creswell (2002: 45) writes that external validity "is concerned with the extent to which the findings of one study can be applied to other situations". In positivists' work, the concern often lies in demonstrating that the results of the work at hand can be applied to a wider population. Since the findings of a qualitative project are specific to a small number of particular environments and individuals, it is impossible to demonstrate that the findings and conclusions are applicable to other situations and populations. Johnson et al., (2007: 67) note that many naturalistic inquirers believe that, in practice, even conventional generalisability is never possible as all observations are defined by the specific contexts in which they occur. A contrasting view is offered by Lincoln and Guba (2000: 78), who suggest that, although each case may be unique, it is also an example within a broader group and, as a result, the prospect

of transferability should not be immediately rejected. Nevertheless, such an approach can be pursued only with caution since it appears to belittle the importance of the contextual factors which impinge on the case.

Lincoln and Guba (2000: 89) propose that, if practitioners believe their situations to be similar to that described in the study, they may relate the findings to their own positions. Lincoln and Guba (2000: 102) are among those who present a similar argument, and suggest that it is the responsibility of the investigator to ensure that sufficient contextual information about the fieldwork sites is provided to enable the reader to make such a transfer. After perusing the description within the research report of the context in which the work was undertaken, readers must determine how far they can be confident in transferring to other situations the results and conclusions presented. In this study, a description of the phenomenon under investigation was provided to allow readers to have a proper understanding of it, thereby enabling them to compare the instances of the phenomenon described in the research report with those that they have seen emerge in their situations.

In this particular study information on the following issues is given at the outset:

a) The number of organisations taking part in the study and where they are based;

b) Any restrictions in the type of people who contributed data;

c) The number of participants involved in the fieldwork;

d) The data collection methods that were employed;

e) The number and length of the data collection sessions; and

f) The time period over which the data was collected.

3.2.3 RESEARCH DESIGN: QUANTITATIVE

Creswell (2008: 4) explains that quantitative research is a means for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures. A survey research design was used because it provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population. It includes cross-sectional and longitudinal studies using questionnaires for data collection, with the intent of generalizing from a sample to a population.

3.2.3.1 Data Collection and Recording

Data were collected by means of a structured closed-ended and open-ended questionnaire. A questionnaire is a self-report data-collection instrument that each research participant fills out as part of a research study (Johnson *et al.*, 2008: 170). A structured closed-ended questionnaire has questions that forces participants to choose from a set of predetermined responses. The questionnaire was used in this study to gather information on the views of the Mathematics teachers and learners about the migration of learners from Mathematics to Mathematical Literacy as well as the choosing of the subject in Grade 10. The questionnaire had open and closed-ended questions. Questionnaires were given to Mathematics and Mathematical Literacy teachers and learners. In order to enhance accuracy, clarity and ease of respondent completion of the questionnaire the researcher explained the purpose of the study to respondents. To guarantee confidentiality no names were indicated. A follow up questionnaire was administered to those who could not complete it the first time.

3.2.3.2 Population and Sampling

A population is a set of all elements; the large group to which a researcher wants to generalize his or her sample results (Johnson *et al.,* 2008: 224). In other words, it is the total group that you are interested in learning more about. This study was conducted at three selected schools of Rekopantswe Area Office in Mahikeng. These three schools have a total number of 950 learners in the FET band and 33 teachers including the SMTs and 6 teachers of Mathematics and Mathematical Literacy; therefore the desired sample was selected by means of random sampling for the learners. Johnson *et al.* (2008: 223) define a sample as a set of elements taken from a larger population according to certain rules. The target population in this study was the learners, who are admitted to the schools doing Mathematics and Mathematical Literacy, teachers of Mathematics and Mathematical Literacy and SMTs. Criteria for selecting the participants include: (1) being in Grade 10-12 as a Mathematical Literacy/Mathematics learner; (2) teachers, currently teaching Mathematics or Mathematical Literacy Grade 10-12; (3) the SMTs who are the head of department of Mathematics. Learners were randomly selected from the three schools in the following manner.

The researcher obtained the names of all Grades 10-12 learners enrolled in Mathematical Literacy as well as Mathematics and put them in a hat then randomly selected 100 learners, but only 93 learners participated in this study. A total of 102 participants including learners, teachers and SMTs in the schools met the criteria discussed in the above paragraph. For the purpose of quantitative study the random sample (Dillman, 2000: 35) was used, which comprised three categories of participants, as identified in the study (1) being in Grade 10-12 as a Mathematical Literacy/Mathematics learner (n=100); (2) teachers, currently teaching Mathematics or Mathematical Literacy Grade 10-12 (n=6); (3) the SMTs who are the Head of

Department of Mathematics (n=3). The instrument used to collect data from the SMT was an interview which is explained in detail in section 3.2.2.4.

3.2.3.3 Measuring Instruments Development, Pretesting, Reliability and Validity

3.2.3.3 (a) Development and Pretesting

The instrument that was used for quantitative data collection was a questionnaire that was developed by the researcher specifically for this study. A questionnaire is a prepared question form submitted to certain persons with a view to obtaining information (Johnson *et al.,* 2008: 201). A structured questionnaire was used in this research. The structured questionnaire is the one which contains questions with alternative answers which respondents select. The questionnaire consisted of two pages and 17 items. Pretesting of the instrument was done at two schools not involved in the study, before it was used in the selected schools. The results of the pre-test had an influence in the items of the final instrument and also the literature review assisted in the development of items to include in the questionnaire.

The questionnaire was used in this study to gather information about the causes of learners' migration from Mathematics to Mathematical Literacy. In order to enhance accuracy, clarity and ease of respondent completion of the questionnaire the researcher explained the purpose of the study to the respondents. To guarantee confidentiality no names were indicated.

3.2.3.3 (b) Reliability and Validity

In quantitative research, reliability and validity of the instrument are very important for decreasing errors that might arise from measurement problems in the research study. Reliability

refers to the consistency or stability of a set of test scores (Johnson *et al.,* 2008: 144). The stability or test-retest reliability of the survey instrument was obtained through pilot testing of the instrument.

Validity refers to the degree to which a study accurately reflects or assesses the specific concept or construct that the researcher is attempting to measure (Gibbs, 2007: 46). Johnson *et al.,* (2008: 150) define validity as the appropriateness of the interpretations, inferences, and actions that we make based on test scores. A total of six teachers from two schools were used for pilot testing the instrument. Face validity is a simple form of content validity that the researcher has employed, few people were asked to check the tool if it covers all areas. Again the researcher consulted few experts in the field of Mathematics to give their opinion on the validity of the tool. Piloting the instruments would help assess whether the questions are relevant to the construct they are aimed to measure, if it is a reasonable way to gain the needed information, and if it is well-designed.

3.2.3.4 Data Analysis

Data were analysed by means of descriptive statistics. The results were summarized and displayed in graphs and tables. Descriptive statistics include the numbers, tables, and graphs used to describe, organize, summarize, and present raw data. Frequency analysis was conducted to identify valid percentages for responses to all the questions in the questionnaire.

3.3 ETHICAL ASPECTS OF THE RESEARCH

Ethical issues are often deemed to be resolved by procedures such as voluntary participation, informed consent, absence of risk or harm, confidentiality, and anonymity. Janse van Rensburg

(2001: 28) describes research ethics as referring to "the moral dimensions of researching about what is right and wrong while engaged in research". Ethical issues were addressed at each phase in the study. In compliance with the regulations the permission for conducting the research was obtained from the schools. Application for research permission contained the description of the project and its significance, methods and procedures, participants, and research status. The interviews with the participants were be audio taped. The study was conducted in a natural setting. An informed consent form was developed for the participants to sign.

The form states that the participants are guaranteed certain rights, agree to be involved in the study, and acknowledge their rights are protected. The anonymity of participants was protected by numerically coding each returned questionnaire and keeping the responses confidential. While conducting the individual interviews with the selected respondents, they were assigned fictitious names for use in describing and reporting the results. When seeking permission from learners for their voluntary participation in the research, the researcher held a preliminary briefing session about the research study. During this briefing session the researcher was deliberately cautious that she does not provide details which could later influence the participants' responses. All study data, including the interview tapes, and journal writings, are kept in a secured place and would be destroyed after a reasonable period of time.

3.4 SUMMARY

Chapter Three presented in detail the research design and methodology, study population and sampling techniques. This chapter further described the instruments that were used to collect data. The research method used was a survey as this research typically employs questionnaires, interviews and journal writings in order to determine the characteristics, opinions, attitudes,

preferences, and perceptions of persons of interest to the researcher. The next chapter take us through the data analysis and interpretation of qualitative and quantitative data. Data is presented separately as per approach.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

This chapter presents the analysis of both qualitative and quantitative data. The qualitative and quantitative data collected in this study were from 93 Mathematical Literacy and Mathematics learners and 6 Mathematics and Mathematical Literacy teachers. It was collected using questionnaires, journal writings by learners and interviews were conducted with three heads of department for Mathematics in the three schools.

4.2 QUALITATIVE DATA PRESENTATION

For the journal writings pseudonyms were used to protect the learners' privacy.

4.2.1 Inductive analysis

4.2.1.1 Analysis of data from interviews and journal writings

Qualitative data were collected through interviews and journal writings. Three HoDs who were in the Mathematics department were interviewed and six learners were given exercise books to write their journals. The purpose of the interviews was to collect information on teachers' views of what causes learner migration from Mathematics to Mathematical Literacy. In the analysis of the responses from the three HoDs and six learners, four (4) themes with regard to what causes learner migration from Mathematics to Mathematical Literacy were listed by the researcher. These were:

i) Theme 1: Mathematics vs. Mathematical Literacy

ii) Theme 2: Migration

iii) Theme 3: Selection of Mathematics or Mathematical Literacy

iv) Theme 4: Mathematical Literacy can be easily passed compared to Mathematics

i) Theme 1: Mathematics vs Mathematical Literacy

All the HoDs indicated that inclusion of contexts in Mathematical Literacy makes Mathematics easy. They all contend that Mathematics has been perceived as a difficult subject because it has no relevance to the real life situation, thus Mathematical Literacy has been structured such that it relates to everyday real-life situation through the inclusion of contexts. They maintain that contexts do not only make Mathematics easy but also assist in making the teaching of Mathematics easy.

Researcher: What is your understanding of Mathematical Literacy?

> ***HoD 1****, it is another branch of Mathematics that was introduced which is more of application in everyday life, for example, concepts in Mathematical Literacy are real life situations, maybe it involves more life situations, for example, if we take topics like finance where learners have to analyse source documents, bank statements, receipts, invoices and questions are involved around there, if we look at project such as measure and calculate amount of maybe paint that is required to paint a classroom like a resent project learners in Grade 11 were doing, you find that it is more application of real life situations.*

HoD 1 considers the contexts that are based on real life situation as facilitating effective teaching and learning, however, he maintains that contexts in Mathematical Literacy make teaching easier.

Researcher: What are your experiences in Mathematical Literacy?

HoD 3: *My experience in Mathematical Literacy is that it deals more with word problems basically learners are able to pass it because most of the questions are based on general information they usually encounter with everyday e.g like finance etc. context makes Mathematical Literacy to be more practical, practical is something that you can see.*

HoD2: *Normally what makes Mathematics to be difficult is that it is based on content only. So the inclusion of context now in Mathematical Literacy, the learners can see what they are doing. It helps a lot because we teach learners what they can see, actual practical thing- it is easy for them to understand if you teach them what they can see.*

HoD 2, drawing from his personal experiences and his personal beliefs about Mathematics, maintains that contexts in Mathematical Literacy are included in order to make Mathematics more practical. He asserts that in the past learners experienced difficulties in learning Mathematics (even now) because it had little of that was related to real life situations, hence learners could not see what they were doing.

Another important point HoD 3 makes is that contexts make Mathematical Literacy practical. He links 'practical' with 'something that you can see'.

HoD 2*: So the inclusion of context now, the learners can see what they are doing. It helps a lot because we teach learners what they can see, actual practical thing- it is easy for them to understand if you teach them what they can see.*

HoD 2*: Yaa! The way Mathematical Literacy been structured, it has moved away from theory to practical. So students can solve things that they see than solving x and y. so context first then content...*

HoD 2 links 'practical' and 'easy'. He contends that learners will find Mathematical Literacy easy if it is presented as practically as possible, through the inclusion of contexts.

Considering the above responses from the HoDs, it is evident that they value contexts in Mathematical Literacy; HoD 1 links practical Mathematics with Mathematical Literacy. He

contends that contexts make Mathematics more practical and thus make Mathematical Literacy easy.

Researcher: Why did you choose Mathematical Literacy?

> **Learner 2**: *I chose to do Mathematical Literacy because it is easy and understandable, again it is enjoyable. I enjoy most of the lessons especially when treating new topics because I get to know something new. I also get frustrated when I am taught and I do not understand.*

Learner 2 chose Mathematical Literacy because according to him it is easy, understandable and enjoyable, meaning that Mathematics is difficult according to this particular learner.

> **Learner 6**: *I chose to do Mathematical Literacy because of the career I wanted follow, I want to be a fashion designer and according to my little research it does not need pure Mathematics. By the way, in Grade 9 I struggled a lot with Mathematics so I was over the moon to learn that I can be a fashion designer without doing Mathematics. Starting from the beginning of this year I enjoy doing Mathematical Literacy it is easy, fun and interesting because you are taught things that you usually interact with in your everyday life.*

Learner 6 chose Mathematical Literacy because of her career in fashion design and again Mathematics in Grade 9 was not easy for her. Since she has started doing Mathematical Literacy she enjoys the subject, according to her it is easy, fun and interesting because she is taught things that she usually interacts with.

> **Learner 4**: *I chose to do Mathematical Literacy because I was failing Mathematics in Grade 9, I got level 1 but my problem was that I was not practicing. I learned my lesson now in Grade 10 - it is a little bit heavy it is a must that you have to study. So far Mathematical Literacy is easy and understandable, also again it is enjoyable.*

Learner 4 chose Mathematical Literacy because she failed Mathematics in Grade 9 but her reason for failure was that she was not studying or paying enough attention to her school work so she learned the lesson the hard way. She also maintains that Mathematical Literacy is easy, understandable and enjoyable.

ii) Theme 2: Migration

According to the three HoDs and three learners who wrote the journals there is migration of learners from Mathematics to Mathematical Literacy. The three learners are the very good source of information since they are the ones who migrated.

Researcher: What do you think could be the possible reason of learner migration?

> ***HoD 1**: Well, One, I think there is a perception that Mathematical Literacy is an easy way out, learners' think Mathematical Literacy is an easy way out if Mathematics is giving you problems. Secondly, learners would consider the subject they are doing for example in FET a learner would fail if they failed two subjects so they weigh their options to say maybe if they are doing a combination which involves Mathematics and Economics so if they have a problem with Economics and also in Mathematics they would know that they would eventually fail, so what do they do? They would say they can't drop Economics but they can drop Mathematics and do Mathematical Literacy to increase their chances of passing to go to the next Grade so the issue of passing and going to the next Grade is the ones learners normally use to migrate to Mathematical Literacy.*

HoD 1 contends that learners think that Mathematical Literacy is an easy way out if Mathematics is giving one a problem and again failing is another reason that makes learners to migrate he said they weigh their options.

***HoD 2**: it happens during the registration of learners from Grade 9 to Grade 10. Teachers were taking learners who passed Maths with the highest levels, e.g., learners who obtained good results in Maths, i.e., from level 4 to 7. Learners who got bad results in Maths were taken to Mathematically Literacy classes.*

HoD 2 mentioned that the migration happens during the registration of Grade 9 learners to Grade 10 since teachers were the ones who were allocating learners to Mathematics or Mathematical Literacy.

***HoD 3**: in most cases learners move from Mathematics to Mathematical Literacy in Grade 10 and 11. The reason I think learners move from Mathematics to Mathematical Literacy is that they do not want to fail or repeat any Grade, most of these learners struggle in Grade 9 with their Mathematics basically because they do not practise and most of the learners in Grade 9 particularly in my school they were pushed to Grade 9 and some of them are repeating Grade 9 more than once because they fail Mathematics and end up hating the subject so if one pass to Grade 10 immediately migrate from Mathematics to Mathematical Literacy. Another reason that might cause the migration is the introduction of Mathematics from the lower Grade some learners place themselves in Mathematical Literacy classes because of the way the subject was introduced to them they end up not wanting anything to do with Mathematics not necessary that they can't cope doing Mathematics if a learner does Mathematical Literacy and get a level 7 it means that learner is capable of doing good in Mathematics.*

HoD 3 is in agreement with what HoD 1 said about failing or repeating a grade that it makes learners to migrate. Another reason she mentioned was the introduction of Mathematics from the lower grade if Mathematics is not properly introduced learners tend to hate the subject.

***HoD 1**: It is rare for learners to migrate from Mathematical Literacy to Mathematics but this year I had a rare case whereby I was teaching a Grade 10 learner Mathematical Literacy. Last year I could see that the learner was dedicated to her work and the way she was able to reason at higher cognitive level, I could see that she was capable to do*

Mathematics so I asked her what she wanted to do after finishing matric, she said she wanted to be a chartered accountant. I said to her she could increase her chances of being an accountant by doing Mathematics so I asked her if she was willing to try. She said yes, and then I took her to Mathematics class in Grade 11. Fortunately, I was also teaching the Grade 11 Mathematics class so I migrated with her from Mathematical Literacy to Mathematics in Grade 11and currently she is doing well actually above average although I had to work extra had to make her catch up with the Grade 10 content but I think it was worth it.

HoD 1 agrees that it is rare for a learner to migrate from Mathematical Literacy to Mathematics but he had encountered a situation whereby one learner migrated from Mathematical Literacy to Mathematics and the learner now is above average in her class. This implies that there are so many learners who are placed in Mathematical Literacy classes with the capability of doing Mathematics.

HoD 1: *one point to stress out is why learners usually drop Mathematics and it is a plea, the basics and the introduction of Mathematics from the lower Grade from foundation phase is very crucial for making learners to like Mathematics. Where I was teaching before in a foundation, intermediate and senior phase school, I remembered a situation, a Grade 3 teacher asking what is bigger between a third and a quarter but she was supposed to be teaching Grade 3 learners Mathematics, so I think the knowledge of Mathematics at lower level is lacking from teachers. So, I do not think Mathematics would be given a priority if a teacher is struggling with Mathematics and once the foundation is lacking you might build a beautiful building with no foundation which is useless, the introduction of Mathematics is very crucial again there was a gap between Grade 8 to 9 especially the introduction of algebra which is one of the fundamental concept for FET Mathematics algebra is a serious challenge to Grade 9 learners so if the majority of learners do not cope they make it clear that in Grade 10 they won't do Mathematics. If algebra could be introduced from Grade 7 in its pure form, and let these learners get used to it I don't think it would still be a bigger challenge in Grade 9.*

HoD 1 emphasized that the introduction of Mathematics at lower grade is very important for making learners to like Mathematics. He further emphasized that if a teacher is struggling with Mathematics, Mathematics would not be given a priority. Algebra as one of the fundamental concepts in Mathematics is a serious problem to Grade 9 learners, if it could be introduced a little bit early maybe in Grade 7 in its pure form we could solve the problem of migration.

Researcher: Why did you change from Mathematics to Mathematical Literacy?

> **Learner 1**: *The reason for my change to Mathematical Literacy was that in Grade 10, I was doing Mathematics and because I was playing, did not practice it every day, I ended up failing Mathematics. I also did not believe in myself I always use to tell myself that Mathematics was difficult but the truth of the matter is that Mathematics is not difficult it just needs more time for practicing. The other reason I changed was that I did not understand the teacher who was teaching the subject most of the time. So, the better solution for me was to change to Mathematical Literacy this year. I knew it again that if I continued with Mathematics, I was going to fail so the better option was Mathematical Literacy because I knew it that I will pass it and so far it is working out well.*

Learner 1 did not practice and she was playing and she ended up failing since she did not believe in herself. Again she did not understand the teacher who was teaching Mathematics. The only solution for her was to change to Mathematical Literacy since she did not want to fail.

> **Learner 4** *the reason I changed to Mathematical Literacy was that in Grade 10, I was doing Mathematics and it was very hard for me, even if I practice it every day I still end up failing Mathematics. I was also doing Accounting and I was also failing it. So, according to the pass criteria you have to fail at least one subject in order for you to pass. I failed both but my Accounting marks was not very bad I failed with 29%, therefore, I said to myself if I want to pass I better change Mathematics to Mathematical Literacy to increase my chance of passing. But still I had to repeat a Grade which is not nice. Imagine*

your friends are in another Grade and you have to repeat. It is very stressing, but now I have let it go and I am focusing on my school work.

Learner 4 changed to Mathematical Literacy because Mathematics was difficult for him. Even if he practiced he ended up failing it as a result he had to repeat a grade. Therefore, to increase his chances of passing he had to let go of Mathematics.

Learner 5: *I wanted to be a medical doctor with all my heart then I registered for the Science stream in Grade 10. Doing Mathematics and Physics were so tiring I tried my level best to balance my school work and my home chores but it was very difficult. I had to wake up early in the morning, catch a bus to school around 5h30 am and get home late again around 5 to 6 pm, when I get home I have to cook so all this things were very strenuous to me, I ended up not having enough time to practice my Mathematics and Physics. I failed Grade 10 but I was condoned to Grade 11. Still in Grade 11 I had it tough and again ended up failing Grade 11 and repeating this Grade then I told myself that if I want to finish school I better change my Mathematics to Mathematical Literacy and change from Physics to Geography since you cannot do physics with Mathematical Literacy. It was still tough to adjust to Geography but Mathematical Literacy was fun and enjoyable I did not struggle with it.*

Learner 5 chose to do Mathematics because of her choice of career but could not cope due to many reasons she mentioned above then ended up changing from Mathematics to Mathematical Literacy after realising she was not winning.

The HoDs and the Learners contend that failing and repeating a grade is one of the major cause of migration from Mathematics to Mathematical Literacy. No one wants to be an ancestor at school, meaning that no learner wants to stay at school more than the required number of years.

iii) Theme 3: Selection of Mathematics or Mathematical Literacy

Selection of subjects in Grade 10 is supposed to be a learner's choice but now when it comes to Mathematics and Mathematical Literacy many learners become confused then consider their Grade 9 results and seek advice from teachers, parents and friends.

Researcher: How are learners selected in Grade 10 for Mathematics and Mathematical Literacy?

> **HoD 1**: *To tell the truth there was no any specific formula it is only last year whereby we tried to select some learners who had level 3 in Mathematics in Grade 9 final result so that they can attempt to do Mathematics, ideally what should happen is that learners should be given a chance to choose and the school should hold career guidance fairs so that learners could be able to choose, hold them maybe at the beginning of Grade 9 or in the middle so that learners should be able to know what they would want to do at tertiary education so that they would know what courses they would do and which subject they need to do so that even in Grade 9 we tell them if you want to do this you should do these subjects so that they would be given the opportunity to choose which subject they want to do maybe because of our experience were by we saw that learners whom we had given a choice of subject before any career guidance they would have a lot of problems with the Mathematics because they just chose it maybe it was prestigious to do it and then half way they realise maybe that's not what I want or maybe their performance will decide for them that I can't take it anymore and then they would decide to change so we done the choosing for them ourselves to say okay anyone with a key three we gave them a chance to do Mathematics from Grade 9. The Grade 9 results play a role in their choices.*

HoD 1 is clearly aware about the procedure that should happen when learners select Mathematics or Mathematical Literacy but now because of the past experience they had to intervene as a school to help assist learners with their choice by choosing learners with level 3 and above to do Mathematics.

***HoD 2**: Previously the school was selecting Maths learners based on the performance from Grade 9 results particularly looking at the Maths levels. It was proposed this year that the school must select more learners in Maths classes than Mathematically Literacy. The reason for this selection was to meet the mandate of the Department of Education "school must increase the number of learners who are doing Maths to maximise the number of scarce skills in the country e.g. engineering etc."*

HoD 2 contends that the school was selecting Mathematics learners based on their performance in Grade 9 Mathematics results. Lately, the school has changed because there was a proposal from the Department of Education that schools must increase their number of learners who are doing Mathematics. The school now takes learners with level 2 also to do Mathematics.

***HoD 3**: Well, before learners use to choose for themselves which subject to take in Grade 10 particularly between Mathematics and Mathematical Literacy and then the school realise that many learners were taking Mathematical Literacy leaving Mathematics with few learners, and then they started selecting learners for Mathematics by looking at the learners Grade 9 results for Mathematics meaning that level 3 and above they put you in Mathematics unless really the learner does not want to but before they do that some teachers sit the learners down and tell them about different careers and how important is Mathematics in all that.*

HoD 3 is firm that learners previously were given a chance to choose but after realising that many learners would choose Mathematical Literacy leaving Mathematics with few learners they decided to intervene and select learners based on their performance in Grade 9 Mathematics results but firstly they sit learners down and tell them about the importance of Mathematics.

Theme 4: Mathematical Literacy can be easily passed compared to Mathematics

The HoDs and learners all agree that Mathematical Literacy can be easily passed compared to Mathematics. Even though HoD 1 thought that it is a perception.

> ***HoD 1**: This thing with Mathematics and Mathematical Literacy is a perception with my experience Mathematics and Mathematical Literacy as the concepts are the same because Mathematics is Mathematics, so, a learner who has a problem with Mathematics would definitely have a problem with Mathematical Literacy so the passing of Mathematical Literacy comes about because of the structure of the papers if you look at paper 1 Mathematical Literacy it is first and second cognitive levels that is knowledge and routine procedures only so if it out of 150 marks mainly they are tested on knowledge, reproduction and routine procedures and then a small percentage maybe 25% complex, then paper two you find out that it requires complex procedures and problem solving so learners usually pass Mathematical Literacy because they normal do well in paper one but paper 2 is a problem it is really a challenge to Mathematical Literacy learners some of the topics there they are difficult I see no difference between Mathematics and Mathematical Literacy when it comes to paper 2 but if they do well in paper one they can pass with paper 1 only since the pass mark is 30%.*

HoD 1 agrees that Mathematical Literacy can be easily passed by doing very well in paper one which is what the learners are doing. According to him, most learners find Mathematical Literacy paper two challenging, he compares paper two with Mathematics when it comes to its complexity but learners tend to do very well in paper one so combined with paper two makes them to pass since 30% is a pass.

> ***HoD 2**: In reality Mathematics is more challenging than Mathematically Literacy. However, there are learners who still cannot pass Mathematical Literacy. I personally think that for one to pass any subject, hardworking and motivation plays a pivotal role.*

HoD 2 contends that Mathematics is more challenging than Mathematical Literacy. He acknowledge that there are some learners who fail Mathematical Literacy, personally he thinks hardworking and motivation plays a very important role when it comes to one passing a subject.

> ***HoD 3**: Learners basically pass Mathematical Literacy more easily because most of the questions are based on knowledge and routine procedure with few abstract problem solving and again it takes hard work and dedication from an individual to make it in life. I believe it is much easier to practise something that you understand and relate with in every way.*

HoD 3 agrees that Mathematical Literacy is easily passed, she further elaborates that it is because of the nature of its questions that most learners pass it. The questions are based on knowledge and routine with less abstract problem solving. Hard-work and dedication is what it takes for an individual to make it in life.

All the learners agree that Mathematical Literacy is easy, fun, interesting and enjoyable. It can be assumed that since it is easy they are passing it and three of the learners migrated from Mathematics to Mathematical Literacy meaning Mathematical Literacy is easily passed compared to Mathematics. The HoDs also contend that Mathematical Literacy is easily passed due to the nature of the questions.

4.2.2 Typological analysis

4.2.2.1 Category 1: Nature and extent of learners' movement from Mathematics

This category covered all information that indicated the nature and extent of learners' movement from Mathematics to Mathematical Literacy.

HoD 1: the basics and the introduction of Mathematics from the lower Grade from foundation phase is very crucial for making learners to like Mathematics. Where I was teaching before in a foundation, intermediate and senior phase school, I remembered a situation, a Grade 3 teacher asking what is bigger between a third and a quarter but she was supposed to be teaching Grade 3 learners Mathematics, so I think the knowledge of Mathematics at lower level is lacking from teachers. So, I do not think Mathematics would be given a priority if a teacher is struggling with Mathematics and once the foundation is lacking you might build a beautiful building with no foundation which is useless.

According to HoD 1 the introduction of Mathematics in the lower grades is very important in making learners to like Mathematics. He further mentioned that some teachers are struggling with Mathematics especially in the lower grades.

HoD 3: another reason that might cause the migration is the introduction of Mathematics from the lower Grade some learners place themselves in Mathematical Literacy classes because of the way the subject was introduced to them they end up not wanting anything to do with Mathematics not necessary that they can't cope doing Mathematics if a learner does Mathematical Literacy and get a level 7 it means that learner is capable of doing good in Mathematics.

HoD 3 is in agreement with HoD that the way Mathematics is introduced in the lower grade is very important in making these learners not to hate the subject. If learners do Mathematical Literacy and get level 7 it means that those learners did have a chance of passing Mathematics.

4.2.2.2 Category 2: Causes of migration

This category covered all information that indicated the causes of migration of learners from Mathematics to Mathematical Literacy.

Researcher: What do you think could be the possible reason of learner migration from Mathematics to Mathematical Literacy?

> **HoD 1**: perception that Mathematical Literacy is an easy way out, learners' think Mathematical Literacy is an easy way out if Mathematics is giving you problems.

> **HoD 1**: Secondly, learners would consider the subject they are doing for example in FET a learner would fail if they failed two subjects so they weigh their options to say maybe if they are doing a combination which involves Mathematics and Economics so if they have a problem with Economics and also in Mathematics they would know that they would eventually fail, so what do they do? They would say they can't drop Economics but they can drop Mathematics and do Mathematical Literacy to increase their chances of passing to go to the next Grade so the issue of passing and going to the next Grade is the ones learners normally use to migrate to Mathematical Literacy.

HoD 1 contends that it is a perception that Mathematical Literacy is an easy way out if Mathematics is giving one a problem. Again the issue of passing to progress to the next grade is the one that learners use to migrate to Mathematical Literacy.

> **HoD 2**: Teachers were taking learners who passed Maths with the highest levels, e.g., learners who obtained good results in Maths, i.e., from level 4 to 7. Learners who got bad results in Maths were taken to Mathematically Literacy classes.

HoD 2 points out that the migration was done by teachers whereby they placed learners with level 4-7 in Mathematics classes and learners with bad results level 1 and 2 placed in Mathematical Literacy.

> **HoD 3**: learners move from Mathematics to Mathematical Literacy is that they do not want to fail or repeat any Grade, most of these learners struggle in Grade 9 with their Mathematics basically because they do not practise and most of the learners in Grade 9 particularly in my school they were pushed to Grade 9 and some of them are repeating

Grade 9 more than once because they fail Mathematics and end up hating the subject so if one pass to Grade 10 immediately migrate from Mathematics to Mathematical Literacy.

HoD 3: Another reason that might cause the migration is the introduction of Mathematics from the lower Grade some learners place themselves in Mathematical Literacy classes because of the way the subject was introduced to them they end up not wanting anything to do with Mathematics not necessary that they can't cope doing Mathematics if a learner does Mathematical Literacy and get a level 7 it means that learner is capable of doing good in Mathematics.

From these responses, HoD 3 contend that failing and repeating a grade is one of the factors causing migration and the introduction of Mathematics from the lower grade makes learners hate the subject.

HoD 1: introduction of Mathematics is very crucial again there was a gap between Grade 8 to 9 especially the introduction of algebra which is one of the fundamental concept for FET Mathematics algebra is a serious challenge to Grade 9 learners so if the majority of learners do not cope they make it clear that in Grade 10 they won't do Mathematics.

HoD 1 agrees with HoD 3 that the introduction of Mathematics is very important in making learners to like and love Mathematics.

4.2.2.3 Category 3: What strategies can be devised to manage the problem of migration?

This category covered all information that indicated the solution in managing the problem of migration.

HoD 1 If algebra could be introduced from Grade 7 in its pure form, and let these learners get used to it I don't think it would still be a bigger challenge in Grade 9 and learners would not run away from Mathematics because of their results in grade 9.

HoD 1 proposed that algebra be introduced as early as in Grade 7 in its pure form so that learners will get used to it maybe this might eliminate the challenges faced in Grade 9 Mathematics.

HoD 3: the government must find a way of equipping learners with the relevant subjects that will help elevate the shortage of scarce skilled professions by intervening and checking why learners are falling Mathematics and come up with solution or intervention plans, etc.

HoD 3 proposed that the government must intervene by checking why learners are failing Mathematics and come up with interventions strategies not give learners irrelevant subjects.

HoD 2: the Department's focus should be on equipping young people with subjects that will enable them easily access to higher education and training institutions which in turn will fulfil the shortage of skilled professions.

HoD 2 proposed that the department should focus on equipping young people with relevant subjects that will enable them easy access to higher institutions of learning by doing so they will fulfil the shortages of skilled professions.

4.3 QUANTITATIVE DATA PRESENTATION

The results from descriptive statistics calculated in the analysis of the questionnaire items was summarized and displayed in graphs and tables. The researcher distributed 100 questionnaires and only retrieved 93 from learners. The 93 questionnaires comprise of 24 Mathematics learners and 69 Mathematical Literacy learners from the 69 questionnaires only 45 were filled

correctly and the 24 were not usable. Again 6 questionnaires were administered to teachers and the retrieval was 100%. The researcher started with the analysis of the questionnaire for learners. Section A of the questionnaire referred to background or biographical information which was used to compare groups of respondents. The frequency table and graphs were used to display the data. The next Table 4.1 displays the demographic data of respondents which was sought in question 1-5 of the learners' questionnaire.

Table 4.1 Demographic data of respondents

		Frequency	**Percentage**	**Cumulative frequency**
Gender	Female	39	57	57
	Male	30	43	100
	Total	69	100	
Age	Below 16	3	4	4
	16 and above	66	96	100
	Total	69	100	
Ethnicity	Black	68	99	99
	Coloured	1	1	100
	Total	69	100	
Grade	10	41	60	60
	11	12	17	77
	12	16	23	100
	Total	69	100	

Area of residence	Urban	1	1	1
	Rural	68	99	100
	Total	93	100	

The findings from the demographic data of respondents is that the majority of learners who have taken part in this research are doing Grade 10 mostly female above 16 years of age from the rural area and are black.

The next table displays importance of factors in relation to the choice of Mathematics or Mathematical Literacy, which addresses question 7 in the learners' questionnaire. The total number of participants in this Table is 24 Mathematics' learners.

Table 4.2: Importance of factors in the choice of Mathematics

No	Items	Level of importance									
		Extremely important		Very important		Important		Unimportant		Total frequency	Total %
		F	%	F	%	F	%	F	%		
1	ML is not a favourite subject	1	4	0	0	3	13	20	83	24	100
2	Prefer to do Maths	15	68	7	32	0	0	0	0	22	100
3	ML is for slow learners	2	9	0	0	7	32	13	59	22	100

4	ML has limited jobs	11	50	3	14	3	14	5	22	22	100
Total		29	32	10	11	13	14	38	43	90	100
Frequency missing: 6											

This table shows that most of the participants (83%) thought that it was unimportant that Mathematical Literacy is not their favourite subject of which 100% prefer to do Mathematics. This suggests that Mathematics learners do not have a problem with Mathematical Literacy but they prefer to do Mathematics. Many of the participants (59%) indicated that it was unimportant that Mathematical Literacy is for slow learners while 41% thought that it was important. Then one can assume that the 41% of the participants when they look at learners who are doing Mathematical Literacy they think of them as slow learners who could not cope in Mathematics. Furthermore, 77% of the participants indicated that it is important to know that Mathematical Literacy has limited jobs. This implies that the more schools are producing Mathematical Literacy learners the more the jobs become limited. The next Table 4.3 displays the important factors in relation to the choice of Mathematical Literacy which was intended to be answered by 69 participants who are doing Mathematical Literacy.

Table 4.3: Importance of factors in the choice of Mathematical Literacy

No	Items	Level of importance					
		Extremely important	Very important	Important	Unimportant	Total	Total %

		F	%	F	%	F	%	F	%		
1	Choosing ML/M based on career	9	20	10	22	16	36	10	22	45	100
2	Choosing ML because friends are doing it	0	0	0	0	4	9	41	91	45	100
3	Think that maths is difficult	19	42	9	20	11	24	6	14	45	100
4	Teachers advice to learners	8	18	2	4	7	16	28	62	45	100
Total		36	20	21	12	38	21	85	47	180	100
Frequency missing: 0											

The results shown in Table 4.3 indicate that the majority of participants (78%) thought that it is important to do Mathematical Literacy and Mathematics based on the career one want to follow. While this is very gratifying, it is worth mentioning there were 22% of the participants who thought it was unimportant, indicating that there are learners who are doing Mathematical Literacy for the sake of finishing school but not for the career one intends to follow. This is very interesting that the majority of participants (91%) do not do choose Mathematical Literacy because friends are doing the subject, but still it is worrying that 9% of the participants thought that it was important. This implies that there are few learners who are choosing the subject because of friends. Mathematical Literacy is chosen because learners think that Mathematics is difficult since 86% of the participants indicated that it was important. The assumption that

Mathematics is difficult is the one that helps them to make the choice. The teacher's advice to learners is not important in learners, 62% of the participants agreed to that. This implies that the teachers do give advice but at the end the learner is the one who must make the decision of taking Mathematical Literacy or Mathematics but it is significant that 38% of these learners do take the advice from teachers. Table 4.4 displays level of importance of reasons for career choice which were asked in question 11 of the learners' questionnaire.

Table 4.4: Level of importance of reasons for career choice

No	Items	Level of importance									
		Extremely important		Very important		Important		Extremely unimportant		Total frequency	Total %
		F	%	F	%	f	%	F	%		
1	Learners choose preferable career	27	60	10	22	7	16	1	2	45	100
2	Learners choose affordable career	5	11	16	36	16	36	8	18	45	100
3	Learners choose career that pays more	7	16	17	37	14	31	7	16	45	100
4	Learners choose career that offers more job opportunity	16	36	17	37	10	22	2	5	45	100

Total	55	31	60	33	47	26	18	10	180	100
Frequency missing: 0										

The results in Table 4.4 show that the majority of the participants (98%) think it is important to choose a preferable career. Meaning that it is best to choose a career that you like so that you do not become bored. Eighty-two percent of the participants indicated that it is important to choose an affordable career. This is a disconcerting finding as it implies that majority of learners are targeting the career that they can afford to pay not necessary their preferred choice of career. It can further be assumed that these learners are not aware about bursaries, sponsorship and NSFAS and so on, on their side they are thinking about whether parents will afford. The majority of the participants (84%) thought it was important to choose a career that pays more. This implies that these learners are mainly interested in careers that pay more even though one might not be good or interested in that particular profession. This is one of the reasons you find people who are frustrated at work, they are doing something they did not like or love because of money. Ninety-five percent of the participants indicated that it is important to choose a career that offers more job opportunities. While this is very gratifying, it is significant that there were two participants who indicated that it was unimportant, indicating that they can go for careers that offer less job opportunities. This might be one of the reasons we have qualified graduates who are unemployed. The next table (Table 4.5) displays factors on which choice of subject (ML) is based. The focus was based in question 12.

Table 4.5: Factors on which choice of subject (ML) is based.

No	Items	Level of importance											
		Very important		Important		Not sure		Unimportant		Total unimportant		Total frequency	Total %
		F	%	F	%	F	%	f	%	F	%		
1	Career intended to be followed	17	38	15	33	8	18	3	7	2	4	45	100
2	Grade 9 Maths final results	18	40	14	31	5	11	2	4	6	14	45	100
3	Advice from friends	5	11	16	36	5	11	7	16	12	26	45	100
4	Advice from Maths teachers	13	29	11	24	3	7	5	11	13	29	45	100
5	Advice from parents	11	24	16	36	3	7	4	9	11	24	45	100
Total		64	28	72	32	24	11	21	9	44	20	225	100
Frequency missing: 0													

The results in Table 4.5 show that the majority of the participants (71%) indicated that it is important to choose Mathematical Literacy based on the career intended to be followed, while 11% of the participants thought it was unimportant. This means that there are some few learners who choose Mathematical Literacy not based on career maybe it might be for the sake of passing. Seventy-one percent of the participants indicated that it is important to choose Mathematical Literacy or Mathematics based on the Grade 9 Mathematics results. This implies that the Grade 9 results serve as a baseline for the choice of Mathematics and Mathematical Literacy. The majority of the participants (53%) thought that it is important to make a choice based on the advice of friends, teachers and parents, while 38% indicated that it is not important. This might be because of a learner's playfulness in Grade 9 which may have resulted having the learner obtained level 1 or 2 in Mathematics. Advice is important but one needs to have serious introspection in order to make correct decisions by looking at the relevant information collected on different careers and what subjects are required for those careers.

The next table (Table 4.6) displays career choices of the learners who are doing Mathematical Literacy. This table addresses question 10 of the learners' questionnaire.

Table 4.6: Careers likely to be chosen

No.	Career	Frequency	%
1	Human Resources (HR)	9	20
2	Engineering	4	9
3	Social worker	15	33
4	Accountant	1	2
5	Other	16	36
Total		45	100

Frequency missing: 0

The results in Table 4.6 indicate that 36% of the participants choose the other option, since their career did not fall under the four career choices that were provided, therefore they specified that they like to be police officers, nurses and so on. The second most likely career is Social Work, third Human Resource, fourth is Engineering and the last likely is Accountancy. It is significant that there were 9% participants who chose Engineering when they are doing Mathematical Literacy not Physical Sciences and Mathematics. This clearly shows a serious lack of career guidance in the schools. The following table (Table 4.7) displays time spent on practising Mathematical Literacy which was asked in question 9.

Table 4.7: Time spent on practising ML

No.	Items	Choice									
		Always		Often		Rarely		Never		Total frequency	Total %
		F	%	f	%	F	%	F	%		
1	After school	8	18	23	51	9	20	5	11	45	100
2	Evening after dinner	8	18	12	27	15	33	10	22	45	100
3	Bed time	5	11	8	18	11	24	21	47	45	100
4	When visiting friend	4	9	13	29	11	24	17	38	45	100
5	At school during lesson	31	68	8	18	3	7	3	7	45	100
Total		56	25	64	28	49	22	56	25	225	100
Frequency missing: 0											

The majority of participants (69%) usually practice Mathematical Literacy afternoon while 11% never in item 1. This suggest that most of the learners do practice Mathematical Literacy after school. In the second item, the many of participants (55%) do not practice Mathematical Literacy in the evening after dinner. The participants (24% & 47%) do not practice

Mathematical Literacy during bed time and when visiting friends only a few does, then the trend changes now the majority of participants (86%) do practice at school during lessons only a minority (14%) do not practice. While this is very gratifying, it is significant that there were 14% of participants who do not practice Mathematical Literacy during lesson; indicating that they attend the Mathematical Literacy class for the sake of attending. Figure 4.1 displays the percentage of learners who are mathematically challenged and learners who took Mathematics either in Grade 10 or 11. The questions addressed in this graph are question 13 and 14.

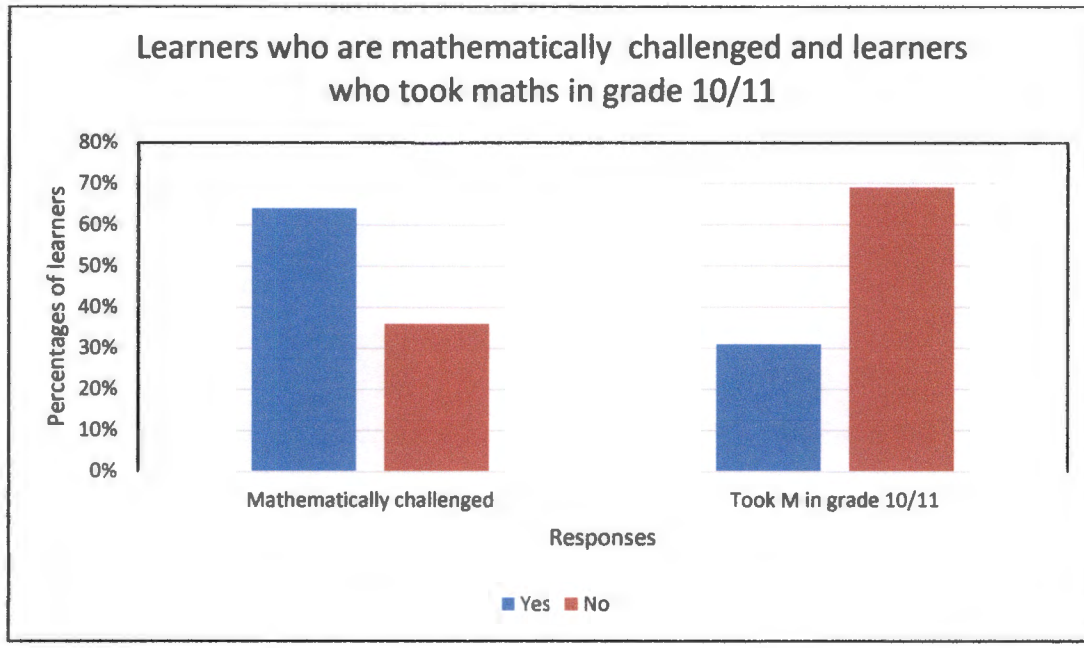

Figure 4.1: Learners who are mathematically challenged and leaners who took mathematics in grade 10/11

In this category only 36% of the participants responded positively to the question. This means that 64% of the participants are mathematically challenged. This is a disconcerting finding as it implies that a large majority of learners are not doing Mathematics because they think they are mathematically challenged. The figure again shows that most of the participants (69%) did not do Mathematics either in Grade 10 or 11. While this is very gratifying, it is significant that

there were 31% of the learners who did Mathematics in Grade 10 or 11, indicating that there is a migration of learners from Mathematics to Mathematical Literacy in schools.

The reasons the 31% of the participants mentioned for the movement to Mathematical Literacy are as follows:

- Mathematics was difficult for some of the learners since the teachers chose the subject for the learners by looking at the Grade 9 results.
- They had no time to practice since the learners are travelling and usually get home late and tired.
- The class teacher advice the learners to change after seeing that they failed the previous year and they were not coping in Mathematics.
- The subject seemed challenging and made some learner's report card look bad.
- Some learners could not cope and nearly failed and then decided to change to Mathematical Literacy. Some say they did not like Mathematics.
- The reasons above suggest that teachers choose Mathematics for these learners.

The next table (Table 4.8) displays statements that learners agreed and disagreed with. The main focus was on question 16 of the learners' questionnaire.

Table 4.8: Agreeing with choices/statements

No	Statement	Choices										Total Frequency	Total %
		SA		A		N		D		SD			
		f	%	F	%	F	%	f	%	F	%		
1	ML increases chances of jobs	10	22	14	31	8	18	9	20	4	9	45	100
2	Doing Maths is a waste of time	2	4	6	13	7	16	10	22	20	45	45	100
3	No need to practice ML	2	4	3	7	6	13	16	36	18	40	45	100
4	Prefer Maths and it has more careers	10	22	12	27	14	31	4	9	5	11	45	100
5	Prefer ML than Maths	16	36	10	22	10	22	4	9	5	11	45	100
6	Maths is difficult	12	27	13	29	7	16	5	11	8	18	45	100
7	ML helps with critical thinking	15	34	13	29	6	13	6	13	5	11	45	100
8	Do ML because of friends are doing it	1	2	1	2	2	4	8	18	33	74	45	100

9	ML is fashionable	1	2	5	11	6	13	11	24	22	50	45	100
10	ML does not stress brain	11	24	17	38	6	13	6	13	5	11	45	100
11	ML is easily passed than Maths	17	38	10	22	9	20	4	9	5	11	45	100
Total		97	20	104	21	81	16	83	17	130	26	495	100
Frequency missing: 0													

The results in Table 4.8 indicate that the majority of the participants (53%) think that Mathematical Literacy increases their chances of acquiring a job. In item number 2 the majority of participants (65%) disagreed that doing Mathematics is a waste of time since the career they want to follow does not require Mathematics. This means that there are learners who realize that mathematics increases their chances of getting into different career fields. It is important to note that there were 17% of the participants who agreed that doing Mathematics is a waste of time, indicating that they are limiting themselves to careers that do not need Mathematics. The majority of the participants (76%) in item 3 disagreed that there is no need to practice Mathematical Literacy, this is very gratifying. In item 4 the participants (49%) prefer Mathematics since it has more career options, while in item 5 and 6 they prefer Mathematical Literacy to Mathematics because Mathematics is difficult. This means that learners are aware that Mathematics has more career options but they do Mathematical Literacy because they know or assume that Mathematics is difficult. In item 7 the majority agreed that Mathematical Literacy helps them to be critical thinkers. It is significant that the learners are not doing

Mathematical Literacy because friends are doing it or it is in fashion since the majority of participants (92% and 74%) disagreed with the statement in item 8 and 9. While in item 10 and 11 the majority of participants (62% and 60%) agreed that Mathematical Literacy does not stress their brains and it is easily passed as compared to Mathematics. This suggests that learners do Mathematical Literacy because they want to pass and they do not want stress. However, it is important to indicate that 24% and 20% of the participants strongly and disagreed respectively that Mathematical Literacy does not stress their brains or that is easily passed. This implies that even though Mathematical Literacy is easy for many of the learners compared to Mathematics, there are those who still find the subject challenging.

What the learners think are other benefits of doing Mathematical Literacy:

The learners further went on and said that Mathematical Literacy *"improves arithmetic knowledge; it is simple and easy to understand; it is a little challenging so it needs to be practiced; it requires knowledge and critical thinking; it does not take up much of their time; it helps a lot in knowing general things like finance; Mathematical Literacy is not challenging at all levels but it is interesting"*. The next table (Table 4.9) displays the demographic data of teachers. Which focused mainly on question 1-5 of the teachers' questionnaire.

Table 4.9 Demographic data of respondents (Teachers)

		Frequency	Percentage	Cumulative frequency
Gender	Female	2	33	33
	Male	4	67	100
	Total	6	100	
Age	Below 30	4	67	67
	30 and above	2	33	100
	Total	6	100	
Ethnicity	Black	6	100	100
	Total	6	100	
Highest qualification	Honours	4	67	67
	B.ed	1	16.6	83.6
	Diploma	1	16.6	100
	Total	6	100	

The results shown in Table 4.9 indicate that the majority of participants (67%) are male, below the age of 30 years, black and they have honours in their qualifications. It is significant that the teachers are still young and already they have acquired their honours and probably they are currently doing their master's degrees.

The next paragraph is about the subject the respondents are teaching.

Current subject teaching in Grade 10-12

One teacher teaches Mathematics in Grade 10 only, two teachers teach Grade 10-12 Mathematics, one teacher teaches Mathematical Literacy Grade 10-12 and lastly two teachers teach Grade 11 Mathematical Literacy and Grade 10 and 12 Mathematics.

The results show that teachers are teaching Mathematics from Grade 10-12, only one teacher teaches Grade 10 only, again only one specializes in Mathematical Literacy in Grade 10-12 and two teachers teach Mathematics Grade 10 and 12 and also Mathematical Literacy Grade 11. The next table (Table 4.10) displays general reasons for teaching Mathematics or Mathematical Literacy that were asked in question 6.

Table 4.10: General reasons for teaching M/ML

No	Items	Level of importance								Total frequency	Total %
		Extremely important		Very important		Important		Unimportant			
		F	%	f	%	F	%	F	%		
1	Majored with Maths	5	83	1	17	0	0	0	0	6	100
2	Prefer teaching Maths	4	66	1	17	1	17	0	0	6	100
3	Maths is challenging	0	0	2	33	1	17	3	50	6	100
4	Maths has a wide range of job opportunities	5	83	1	17	0	0	0	0	6	100
5	Enjoy working with numbers	2	33	3	50	1	17	0	0	6	100
6	Qualify to teach ML since majored with M	2	33	1	17	2	33	1	17	6	100
7	So far there is no ML major at university	3	50	0	0	2	33	1	17	6	100
8	ML deals with real life problem	2	33	3	50	0	0	1	17	6	100

9	ML helps with application of M to real life situations	1	17	4	66	1	17	0	0	6	100
Total		24	44	16	30	8	15	6	11	54	100
Frequency missing: 0											

This Table 4.10 in item 1 and 2 shows that all of the participants (100%) majored in Mathematics and they prefer teaching Mathematics. In item 3, 50% of the participants indicated that it is important to note that Mathematics is challenging while the other 50% thought it was not important. This is a disconcerting finding as it implies that 50% of teachers think that Mathematics is challenging meaning that they understand their learners' problems with regard to this subject. In item 4-7 the majority of participants (100%) indicated that it is important to know that Mathematics has a wide range of job opportunities. These teachers enjoy working with numbers and they are qualified to teach Mathematical Literacy since they majored in Mathematics at the university since so far there is no Mathematical Literacy Major at the university. In item 8 and 9 the majority of participants (83%) indicated that Mathematical Literacy deals with real life problems and also helps with the application of Mathematics in real life situations. This means that learners who are doing Mathematical Literacy are able to apply their Mathematics in everyday life situations.

The next Figure 4.2 displays the number of M/ML learners per Grade in the three selected schools. It addresses question 8.

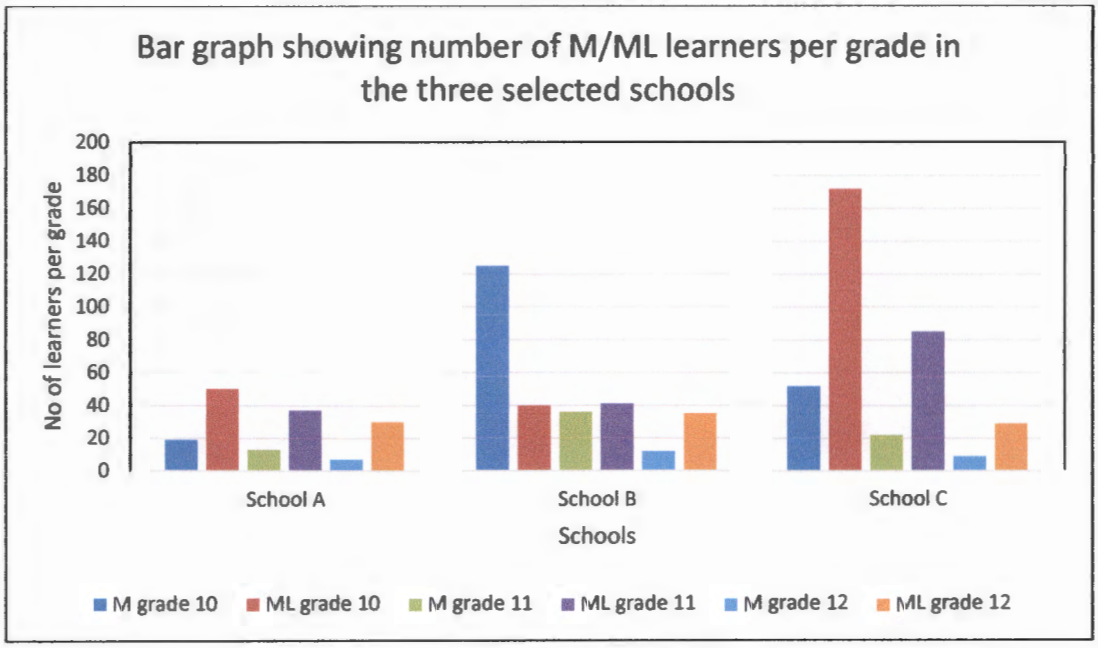

Figure 4.2: Number of M/ML learners per grade in the three selected schools

The results in figure 4.2 show that at school A & C in Grade 10-12 many of the learners are doing Mathematical Literacy and few learners are doing Mathematics. If we look at Grade 12 as an exit class in the three schools 81%, 76% and 75% are learners who are taking Mathematical Literacy while in Mathematics only 19%, 24% and 25% are taking the subject. This is a disconcerting finding as it implies that many learners are produced to do Mathematical Literacy related career fields. It can be assumed that this could create problems in the future since the country will be running short of learners who will do Science related fields etc. School B with regard to their Grade 10, there is a slight change many learners are taking Mathematics there are 76% learners in Mathematics where as in Mathematical Literacy they are 24%. It can be assumed that the school decided to accept learners who had passed their Grade 9 with at least level 2 after realizing that many learners are doing Mathematical Literacy. The next table (Table 4.11) displays teachers' choices on the selection of Grade 10 learners for Mathematics or Mathematical Literacy. It addresses question 9 of the teachers' questionnaire.

Table 4.11: Selection of Grade 10 learners for Mathematics/Mathematical Literacy

No	Selection	Always		Most of the time		sometimes		Rarely		Never		Total frequency	Total %
		f	%	f	%	f	%	f	%	f	%		
1	It is voluntary	0	0	4	66	1	17	1	17	0	0	6	100
2	Teachers advise learners based on Grade 9 results	1	17	3	50	2	33	0	0	0	0	6	100
3	Teachers' selection based on Grade 9 results	0	0	3	50	2	33	1	17	0	0	6	100
4	If M results in Grade 9 final are below 3 then the learner automatically does M	0	0	2	33	4	67	0	0	0	0	6	100
Total		1	4	12	50	9	38	2	8	0	0	24	100
Frequency missing: 0													

This Table 4.11 in item 1 shows that most of the participants (83%) agree that most of the time the selection of Mathematics and Mathematical Literacy in Grade 10 is voluntary. While in item 2, 100% of the participants agree that they advise learners based on the Grade 9 results. It can therefore be accepted that most of the time learners are advised and then voluntarily take

the decision whether to take Mathematics or Mathematical Literacy. In item 3 and 4 the majority of participants (83% and 100%) agree that they select learners based on their Grade 9 results, if the Mathematics result in Grade 9 final is below 3 then the learner automatically is allocated to Mathematical Literacy. It can be assumed that learners whose levels are below 3 do not have a choice of which subject they want but those with level 3 and above have a choice whether to do Mathematics/Mathematical Literacy.

The next paragraph shows how learners are kept interested in the two subjects (teachers said these in the questionnaire):

> "In Mathematical Literacy always relate the problems with the real life situations; learners are engaged in Maths Olympiads, career exhibitions; inviting people to schools to motivate learners; and in Mathematics, teachers also motivates the learners by discussing the career opportunities in Mathematics especially using prospectus from universities".

The next table (Table 4.12) displays teachers' choices based on learner migration which were asked in question 11.

Table 4.12: Learner migration

No	Migration	Choices									
		Always		Often		Rarely		Never		Total f	100%
		F	%	F	%	F	%	F	%		
1	Move from M to ML in Grade 10 and 11	3	50	3	50	0	0	0	0	6	100
2	Move from M to ML in Grade 12	0	0	1	17	5	83	0	0	6	100
3	Move from ML to M in Grade 10 and 11	0	0	0	0	5	83	1	17	6	100
Total		3	17	4	22	10	56	1	5	18	100
Frequency missing: 0											

The results in Table 4.12 indicate that there is movement of learners from Mathematics to Mathematical Literacy in Grade 10/11 since 100% of the participants agreed to that. 83% of the participants indicated that the movement of learners from Mathematics to Mathematical Literacy in Grade 12 it is rare as well as the movement from Mathematical Literacy to Mathematics. It is significant that there was 1 participant who indicated never, meaning that it can be assumed that usually learners do not move from Mathematical Literacy to Mathematics because teachers mentioned that Mathematical Literacy is easily understandable and it is the application of Mathematics in real-life situations. Meaning that learners are able to use the knowledge gained in the subject for their own personal life.

The next Table 4.13 displays teacher's choices based on given statements that they must agree or disagree with, which mainly focused on question 12 of the teachers' questionnaire.

Table 4.13 Statements to agree or disagree with

No.	Statements	Choices											
		SA		A		N		D		SD		Total f	100%
		f	%	f	%	f	%	F	%	f	%		
1	ML increase the learner' chance of getting a job	0	0	0	0	2	33	1	17	3	50	6	100
2	M waste of time because of career	0	0	0	0	3	50	0	0	3	50	6	100
3	Learners struggling with abstract problem solving in M can do ML	1	17	2	33	0	0	1	17	2	33	6	100
4	Learners must do M it has wide range of career fields	3	50	3	50	0	0	0	0	0	0	6	100
5	Maths is difficult	0	0	0	0	0	0	2	33	4	67	6	100
6	ML is easy, it focuses on general problems	2	33	1	17	1	17	2	33	0	0	6	100
7	ML is easily passes compared to M	2	33	2	33	2	33	0	0	0	0	6	99

Total	8	19	8	19	8	19	6	14	12	29	42	100
Frequency missing: 0												

The results shown in Table 4.13 indicate that the majority of the participants (67%) do not think that Mathematical Literacy increases the learners' chance of getting a job, while again 50% of the participants do not think that doing Mathematics is a waste of time even if the learners' career does not require it. The results from Table 4.13 indicate that Mathematical Literacy does not increase the learner's chance of getting a job, Mathematics is not a waste of time even if the career one intends to follow does not require Mathematics. 50% of the participants agree that learners who struggle with abstract problem solving in Mathematics can do Mathematical Literacy while the other 50% disagreed. All of the participants (100%) agree that learners must do Mathematics since it has a wide range of career fields and Mathematics is not difficult. It is gratifying that teachers believe that Mathematics is not difficult but one can ask him/herself a question if it is not difficult why many learners are doing Mathematical Literacy? 50% of participants agreed that Mathematical Literacy is easy since it focuses on general problems. It is significant that 33% of the participants disagreed that Mathematical Literacy is easily passed compared to Mathematics; indicating that learners in order to pass they must do their mile which is to study. The next paragraph lists the benefits of doing Mathematics or Mathematical Literacy: the learners in the questionnaire elaborated on these:

> Mathematics can benefit you in a way that you become a good problem solver and a logical thinker. Mathematics in general provides more job opportunities and various careers. It also increases chances for one to get sponsors, i.e., bursaries or scholarships. Mathematics increase learner's capability of problem solving for any field of study.
> Learners can easily pass Mathematical Literacy because of the perception that it is easier, yet in actual fact it is equally challenging. However, due to that perception,

learners who do Mathematical Literacy and pass it increase their chances of passing matric examination and hereby proceeding with their studies.

4.4 SUMMARY

Chapter Four presented the analysis of both quantitative and qualitative data as well as the findings of each instrument. The quantitative presentation includes the analysis from questionnaires of both teachers and learners while the qualitative presentation included the journal writings done by learners and interviews conducted with the Head of Departments for Mathematics in the three selected schools. Chapter Five presents the summary, discussion, recommendation and conclusion.

CHAPTER FIVE

SUMMARY, DISCUSSIONS, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

This study focused on causes that influence the migration of (Grade 10-12) high school learners from Mathematics to Mathematical Literacy. The purpose of the study was to determine teachers' and learners' views on what causes the migration of Grade 10-12 learners from Mathematics to Mathematical Literacy. A questionnaire was administered. Semi-structured interviews with three Heads of Department for Mathematics were conducted. A journal writing task was given to a sample of six learners from Grade 10 and 11 learners.

The findings from the empirical investigation are compared to the findings from the literature review to determine similarities and differences. This chapter provides a summary of the previous four chapters, the main findings, recommendations made and conclusion from the study.

5.2 SUMMARY OF THE STUDY

The first chapter gave a brief introduction of the research problem which is causes that influence the migration of (Grade 10-12) high school learners from Mathematics to Mathematical Literacy. This chapter also included the main aspect of the research such as the purpose of the research and the research design. The second chapter discussed the literature review and gave in-depth knowledge about the area of the study. This chapter presented the research literature in the field of Mathematics and Mathematical Literacy that informed this study. The literature was based on Mathematics and Mathematical Literacy.

The third chapter focused on the research design and methodology. The research approach, research methods and procedures for collecting data were discussed. The validity and reliability including the ethical considerations were also discussed. The nature of the instrument was discussed and items for the questionnaire were derived from the literature review and the preliminary sets of questions given to teachers and learners.

The fourth chapter addressed the empirical study. This chapter presents the analysis and interpretation of data collected from the instruments used in the study. The data gathered is presented in accordance with the specific problem stated in chapter one.

The fifth and final chapter, presents the summary of the study, the findings from the literature study (Chapter Two) and the empirical study (Chapter Four), recommendations and suggestions for further research.

5.3 SYNTHESIS OF FINDINGS

The findings are discussed under the following analytic categories that emerged from the data in relation to the research questions and the aims of the study stated earlier:

5.3.1 Findings on the nature and extent of learners' movement from Mathematics to Mathematical Literacy

Many issues need to be considered when examining the nature and extent of learners' movement from Mathematics to Mathematical Literacy. These issues can be divided along organisational levels, ranging from government policy on higher education and institutional policies to curriculum development and implementation by individual teachers (cf. Elsen *et al.*, 2009; Jenkins *et al.*, 2005). The empirical investigation reveals that the foundation of Mathematics from the lower grade is very crucial in determining the learners' interest in

Mathematics as the International and National studies have revealed that South African learners have poor Mathematics skills. The performance of Grade 8 learners in the Trends in International Mathematics and Science Study revealed that South African learners had the lowest scores amongst 40 countries (cf. 1.1). The performance of learners in the lower grades is the contributing factor in the migration of learners from Mathematics to Mathematical Literacy. Seventy-one percent of the participants indicated that it is important to choose Mathematical Literacy or Mathematics based on the Grade 9 Mathematics results. This implies that Grade 9 results serve as a baseline for the choice of Mathematics and Mathematical Literacy (cf. Table 4.5). For instantly if a learner did not perform well in Grade 9 it usually meant that the learner in Grade 10 would automatically choose Mathematical Literacy.

The first three of 27 goals in Action Plan to 2014: Towards the realization of Schooling 2025, published by the Department of Basic Education (DBE) in 2010, refer to the need to improve learner performance in Languages and Mathematics at the Grades 3, 6 and 9 levels; in other words at the final Grades of three curriculum phases. Whilst quality education is far more than just adequate competencies in Languages and Mathematics, it is common knowledge that without competencies in these two subjects, quality education in a broad sense is unachievable. The 'gateway' nature of these subjects lies behind the strong focus on the two subjects not just in South Africa, but around the world (cf. 2.10).

5.3.2 Findings on the causes of migration of learners

There are many causes of migration of learners from Mathematics to Mathematical Literacy. The first cause is failing and repeating a grade and this occurs when one has failed two subjects including Mathematics. The second cause is the introduction of Mathematics from the lower grades as well as in Grade 10. If Mathematics is not introduced properly learners end up

resenting the subject which leads to migration. The third cause is learners' perceptions that Mathematical Literacy is an easy way out. Therefore, learners take Mathematical Literacy because they want to pass. The fourth cause is that most learners are not using Mathematics in their practical everyday lives.

Mathematics is a practical subject, it requires a lot of time from learners. The more time spent on practicing the subject the better the results. Learners who do not spend more time practicing Mathematics end up failing the subject and are forced to change to Mathematical Literacy. Learner 3 said *"I chose to do Mathematical Literacy because I was failing Mathematics in Grade 9, I got level 1 but my problem was that I was not practicing" (cf. 4. 2.1.1).*

Learner 1said *"the reason for my change to Mathematical Literacy was that in Grade 10, I was doing Mathematics and because I was playing, did not practice it every day, I ended up failing Mathematics. I always use to tell myself that Mathematics was difficult but the truth of the matter is that Mathematics is not difficult it just needs more time for practicing (cf. 4.2.1.1).*

The other reason some of these learners migrate is that they do not understand the teacher who is teaching the subject most of the time. So, learners opt to do Mathematical Literacy in order to be promoted. Learner 1 practically said it that *"I did not understand the teacher who was teaching the subject most of the time. So, the better solution for me was to migrate to Mathematical Literacy this year" (cf. 4.2.1.1).* A study by Spangenberg (cf. 2.12) revealed that there is a relationship between learners' thinking style dimensions and which subject they are studying. Mathematical Literacy learners are more likely to execute instructions than Mathematics learners. Mathematical Literacy learners design and do things in their own way. Where Mathematics learners are more likely to do many things at the same time and to set priorities pertaining to what to do, at what time to do it and how much time and energy to spend

on it, Mathematical Literacy learners are more likely to do one thing at a time and spend almost all their energy and resources on it.

The interview results revealed that there is a perception that Mathematical Literacy is an easy way out. Learners think Mathematical Literacy is an easy way out if Mathematics is giving them problems. Secondly, learners would consider the subject they are doing, for example, in FET a learner would fail if they failed two subjects so they weigh their options to say maybe if they have a combination of Mathematics and Economics, then if they have a problem with Economics and also with Mathematics they would know that they would eventually fail, so what do they do? They would conclude that they cannot drop Economics but they can drop Mathematics and do Mathematical Literacy to increase their chances of passing to go to the next grade (cf. 4.2.1.1). Therefore, passing and moving on to the next grade level becomes the reason why learners migrate to Mathematical Literacy. The majority of participants agreed that Mathematical Literacy does not stress their brains and it is easily passed as compared to Mathematics (cf. Table 4.8). This suggests that learners do Mathematical Literacy because they want to pass and they do not want the stress associated with Mathematics. It is rare for learners to migrate from Mathematical Literacy to Mathematics. Teachers take learners who passed Mathematics with the highest levels, e.g., learners who obtained good results in Mathematics, i.e., from level 4 to 7 (cf. 4.2.1.1). Learners who got bad results in Mathematics are taken to Mathematical Literacy.

The other reason why learners usually drop Mathematics, is the basics and the introduction of Mathematics from the lower grade, foundation phase is very crucial for making learners like Mathematics. A Grade 3 teacher asking what is bigger between a third and a quarter, yet, she/he was teaching Grade 3 learners Mathematics raises a question about the knowledge of Mathematics at lower level lacking from teachers (cf.4.2.1.1).

Therefore, one could conclude that Mathematics would not be given a priority if a teacher was struggling with Mathematics, and if the foundation is lacking one can build a beautiful building which is useless. Therefore, the introduction of Mathematics is very crucial, there is a gap between Grade 8 to 9 especially the introduction of algebra which is one of the fundamental concepts for FET Mathematics Algebra is a serious challenge to Grade 9 learners so if the majority of learners do not cope they make it clear that in Grade 10 they would not do Mathematics.

According to the learner's responses in the questionnaire, 64% of them are mathematically challenged. This is a disconcerting finding as it implies that a large majority of learners are not doing Mathematics because they think they are mathematically challenged. Most of the participants (69%) did not do Mathematics either in Grade 10 or 11. While this is very gratifying, it is significant that there were 31% of the learners who did Mathematics in Grade 10 or 11, indicating that there is a migration of learners from Mathematics to Mathematical Literacy in schools (cf. figure 4.1). The reason for migration here might be that learners think that they are mathematical challenged.

5.3.3 Findings on how to manage the problem of migration of learners

The information about the thinking styles of learners could be used to help place learners more appropriately and possibly reduce the number of learners who make inappropriate choices. Also, this will ease pressure on teachers who have to deal with larger classes due to subject changes later during a year and may have to re-teach subject content. In support, Borromeo Ferri (cf. 2.12) argued that thinking styles should 'not be viewed as being unchangeable, but they may change depending on time, environment and life demands'. HoD 1 said "*if algebra could be introduced from Grade 7 in its pure form, and let these learners get used to it he does*

not think it would still be a bigger challenge in Grade 9 and obviously if learners master this algebra at the senior phase then this might reduce the failure rate in Grade 9-10 and reduce again the learner migration" (cf. 4.2.2.3).

HoD 3 contend that *"the government must find a way of equipping learners with the relevant subjects that will help elevate the shortage of scarce skilled professions by intervening and checking why learners are falling Mathematics and come up with solution or intervention plans, etc"* (cf.4.2.2.3).

HoD 2 points to the Department that it should focus on equipping young people with subjects that will enable them to easily access higher education and training institutions which in turn will fulfil the shortage of skilled professions.

5.4 RECOMMENDATIONS

In light of the findings, the following recommendations are made:

5.4.1 Recommendation for teacher education

There is great need for a continual teacher in-service programme. The Department of Education should have programmes in place that are designed to support and monitor the teaching in schools to be specific not just coming to monitor files and learners' books but go to class and observe the teacher with an aim of development and support. Each circuit or ward should have clusters (group of teachers) who will meet on regular basis to share experiences on how to approach some of the topics that are challenging, particularly in Mathematics since the majority of learners move from it. The above will ensure that all teachers carry the appropriate message to the classroom. Institutions of higher education should design accredited programmes for

teachers which will be offered part-time to practicing educators. Such programmes should address challenges of the new curriculum (CAPS).

5.4.2 Recommendation for classroom practice

Contexts are central to Mathematical Literacy. It is expected that the learners be exposed to both mathematical content and real-life contexts in order to achieve Learning Outcomes. Teachers must relate what is taught in Mathematics to real-life situations and give learners practical examples such as in analytical geometry where learners calculate distances, mid-points, angles of inclinations and gradients. Teachers need to explain to learners where they are going to use that knowledge in real-life. The findings from the journal writings revealed that learners like Mathematical Literacy because it deals with real life problems; something that the learners can identify with. If this could be practised in Mathematics maybe we might alleviate the problem of migration. Adendorff and van Heerden (2001: 66) suggest that teachers need to make sure that appropriate contexts are used to facilitate learning and understanding, and should change and adapt contexts found in textbooks or other resources to better suit their learners' needs.

5.4.3 Recommendation for the school SMT

The SMT should hold career guidance fairs so that learners can choose their careers. The fair should be held at the beginning of Grade 9 or in the middle so that learners should be able to know what they can do at tertiary level. The fair would help learners make the right subject choices at Grade 9 to assist them with the relevant career choices. The findings from the interviews clearly reveal that career guidance in schools is not done for the Grade 9 learners. Some of the learners in the FET phase are confused. They do not even know that one cannot do Engineering without Mathematics and Physics.

5.4.4 Recommendation for further research

There is a need for further research on how teachers teach Mathematics in the classroom because the findings from the journal writings revealed that some learners change to Mathematical Literacy because they do not understand the teacher. Such research should involve observation of classroom practice. There is also a need for further research on the same topic involving urban schools.

5.5 CONCLUSION

The migration of learners from Mathematics to Mathematical Literacy is clearly a problem in the Rekopantswe schools. The high number of learners enrolling for Mathematical Literacy in the country makes it difficult for university enrolment in Science fields, Accounting, etc., since those fields require Mathematics as the core subject. The findings revealed that Mathematical Literacy is an easy way out if Mathematics is giving one a problem therefore learners are taking Mathematical Literacy because they want to pass; learners opt for Mathematical Literacy in order to be promoted.

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APPENDIX A

QUESTIONNAIRE FOR LEARNERS

PLEASE ANSWER THE FOLLOWING QUESTIONS BY CROSSING (X) IN THE RELEVANT BLOCK OR WRITING DOWN YOUR ANSWER IN THE SPACE PROVIDED

EXAMPLE of how to complete this questionnaire:

Your gender? Place a X in the appropriate box

Male	1
Female	2 X

SECTION A

Background information

This section of the questionnaire refers to background or biographical information.

Although I am aware of the sensitivity of the questions in this section, the information will allow me to compare groups of respondents. Once again, I assure you that your response will remain anonymous. Your co-operation is appreciated.

1. Gender

Male	1
Female	2

2. Age (in complete years) e.g. 16 (if that is your age)

3. Ethnicity

Black	1
White	2
Coloured	3
Indian or Asian	4

4. Your current Grade level?

Grade 10	1
Grade 11	2
Grade 12	3

5. How would you describe the area in which you are residing?

Urban	1
Rural	2

SECTION B

This section of the questionnaire explores your preferences, with regard to Mathematics and Mathematical Literacy.

6. What is the current subject you are doing? Please place an [X] in the appropriate box.

Mathematics	1
Mathematical Literacy	2

If you answered **Mathematics** in question 6, please answer question 7 only. If you answered **Mathematical Literacy** in question 6, please skip question 7 and continue from question 8.

7. The following table contains reasons that are believed to be important for not doing Mathematical Literacy. Please place an [X] in the box which corresponds with your answer. In other words indicate your level of belief that each of the reasons given in the table is important.

Reasons for not doing Mathematical Literacy at school	Extremely important	Very important	Important	Very unimportant
7.1 Mathematical Literacy is not a favourite subject	1	2	3	4
7.2 It is more preferable to do Mathematics	1	2	3	4
7.3 Mathematical Literacy is for slow learners	1	2	3	4
7.4 Mathematical Literacy has limited job opportunities	1	2	3	4

Thank you for your co-operation in completing this questionnaire. Kindly return the questionnaire as specified in the cover letter.

The following questions only pertain to people who are doing Mathematical Literacy at school.

8. Please indicate by means of an **[X]** in the appropriate box – the level of importance of reasons why you chose Mathematical Literacy.

Reasons why I choose Mathematical Literacy at school	Extremely important	Very important	Important	Very unimportant
8.1 I chose it because of the career I wanted to follow	1	2	3	4
8.2 I chose it because my friends have chosen it	1	2	3	4
8.3 I chose it because Mathematics was difficult for me	1	2	3	4
8.4 My teachers advised me to do Mathematical Literacy	1	2	3	4

9. How often do you practise Mathematical Literacy on each of the following occasions? Please place an **[X]** in the appropriate space.

	Always	Often	Rarely	Never
9.1 First thing after school	1	2	3	4
9.2 In the evening after dinner	1	2	3	4
9.3 At bedtime	1	2	3	4
9.4 When visiting friends	1	2	3	4

9.5 At school during its lesson	1	2	3	4

10. What career are you planning to follow?

Human resource	1
Engineering	2
Social worker	3
Bcom Accounting	4
Other	5

Other specify.....

11. The following table contains reasons that are believed to be important for choosing the career you have selected above? Place an [X] in the box which corresponds with your answer.

	Extremely important	Very important	important	Extremely unimportant
11.1 It is the career I prefer	1	2	3	4
11.2 It is the most affordable	1	2	3	4
11.3 It is the career that pays more	1	2	3	4
11.4 It has more job opportunities	1	2	3	4

12. How important is each of the following to you when selecting Mathematics and Mathematical Literacy?

Please indicate your answer by an [X]using the following 5-point scale where

1 = Very important

2 = Important

3 = Not sure

4 = Unimportant

5 = Totally unimportant

	Very important	Important	Not sure	Unimportant	Totally unimportant
12.1 The career I intend to follow	1	2	3	4	5
12.2 The Grade 9 final mark results	1	2	3	4	5
12.3 Advice from friends	1	2	3	4	5
12.4 The Mathematics teacher's advice	1	2	3	4	5
12.5 The parents advice	1	2	3	4	5

13. Do you consider yourself to be mathematically challenged?

Yes	1
No	2

14. Have you ever done Mathematics in Grade 10 or 11?

Yes	1
No	2

15. If you answered yes in the above question, why did you change to Mathematical Literacy?

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SECTION C

This section explores your attitude and perceptions regarding Mathematical Literacy.

16. To what extent do you agree with each of the following statements? Please indicate your answer by an **[X]** using the following 5-point scale where:

1. = Strongly Agree (SA)

2. = Agree (D)

3. = Neutral (N)

4. = Disagree (A)

5. = Strongly Disagree (SD)

	SA	A	N	D	SD

16.1 Doing Mathematical Literacy increases my chance of getting a job	1	2	3	4	5
16.2 Doing Mathematics would be a waste of time since my career does not require Mathematics	1	2	3	4	5
16.3 I do not need to practice Mathematical Literacy since it is general questions that are asked	1	2	3	4	5
16.4 I prefer Mathematics since it has more careers I could study at the university	1	2	3	4	5
16.5 I prefer doing Mathematical Literacy than Mathematics	1	2	3	4	5
16.6 Mathematics is difficult	1	2	3	4	5
16.7 Doing Mathematical Literacy helps me to be a critical thinker	1	2	3	4	5
16.8 I do Mathematical Literacy because my friends are doing it	1	2	3	4	5
16.9 I do Mathematical Literacy because it is fashionable	1	2	3	4	5
16.10 When I do my Mathematical Literacy my brain does not stress I am always relaxed	1	2	3	4	5
16.11 I can easily pass Mathematical Literacy as compared to Mathematics	1	2	3	4	5

17. Please write down in the space provided what you think why it is important to do Mathematical Literacy.

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Thank you for your co-operation in completing this questionnaire. Kindly return the questionnaire as specified in the cover letter.

APPENDIX B

QUESTIONNAIRE FOR TEACHERS

PLEASE ANSWER THE FOLLOWING QUESTIONS BY CROSSING (X) IN THE RELEVANT BLOCK OR WRITING DOWN YOUR ANSWER IN THE SPACE PROVIDED

EXAMPLE of how to complete this questionnaire:

Your gender? Place a X in the appropriate box

Male	1
Female	2 X

SECTION A

Background information

This section of the questionnaire refers to background or biographical information.

Although I am aware of the sensitivity of the questions in this section, the information will allow me to compare groups of respondents. Once again, I assure you that your response will remain anonymous. Your co-operation is appreciated.

1. Gender

Male	1
Female	2

2. Age (in complete years)

3. Ethnicity

Black	1
White	2
Coloured	3
Indian or Asian	4

4. Your highest educational qualification?

Post-Matric Diploma or certificate	1
Baccalaureate Degree(s) State	2
Post- Graduate Degree(s) State: Honors, Masters, etc.	3

Section B

This section of the questionnaire explores your preferences, with regard to Mathematics and Mathematical Literacy.

5. What is the current subject you are teaching in Grade 10-12?

Mathematics Grade 10-12	1

Mathematics Grade 10 only	2
Mathematics Grade 11 only	3
Mathematics Grade 12 only	4
Mathematical Literacy Grade 10-12	5
Mathematical Literacy Grade 10 only	6
Mathematical Literacy Grade 11 only	7
Mathematical Literacy Grade 12 only	8
Other combination of the two subject specify below	9

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6. The following table contains reasons that are believed to be important for teaching Mathematics. Please place an [X] in the box which corresponds with your answer.

Reasons for teaching Mathematics at school	Extremely important	Very important	Important	Very unimportant
6.1 I majored in Mathematics at university	1	2	3	4
6.2 I prefer teaching Mathematics	1	2	3	4
6.3 Mathematics is a very challenging subject	1	2	3	4

6.4 Mathematics has a wide range of job opportunities for learners	1	2	3	4
6.5 I enjoy working with numbers	1	2	3	4

7. The following table contains possible reasons for teaching Mathematical Literacy. Please indicate the level of importance of each reason by placing an [X] in the box which corresponds with your answer.

Reasons for teaching Mathematical Literacy at school	Extremely important	Very important	Important	Very unimportant
7.1 Since I have Mathematics as my major I qualify to teach Mathematical Literacy	1	2	3	4
7.2 There is no specific person who has majored with Mathematical Literacy at university	1	2	3	4
7.3 Mathematical Literacy deals with real life problems so it is interesting	1	2	3	4
7.4 It helps me apply my Mathematics to real life situations	1	2	3	4

8. How many learners of Mathematics and Mathematical Literacy does your school have in Grade 10-12? Write the number in the space provided.

Mathematics Grade 10	
Mathematics Grade 11	
Mathematics Grade 12	
Mathematical Literacy Grade 10	
Mathematical Literacy Grade 11	
Mathematical Literacy Grade 12	

9. Please indicate by means of an **[X]** in the appropriate box- how the school selects learners who are supposed to take Mathematics/Mathematical Literacy in Grade 10.

How learners are selected in Grade 10	Always	Most of the time	Sometimes	Rarely	Never
9.1 Learners voluntarily select the subject they want	1	2	3	4	5
9.2 Teachers assist learners by advising them based on their Grade 9 results for Mathematics	1	2	3	4	5
9.3 Teachers look at the Grade 9 Mathematics results of a learner if it is level 3 or above, then select Mathematics for that learner	1	2	3	4	5
9.4 If the Mathematics results in Grade 9 is below level 3 the learner would be selected Mathematical Literacy	1	2	3	4	5

10. How do you keep learners interested in Mathematics/Mathematical Literacy?

For example: In Mathematics there are Mathematics Olympiads for learners to enter as competition. List your responses below:

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11. How do you often encounter a situation whereby learners migrate from Mathematics to Mathematical Literacy? Please place an [X] in the appropriate box.

Migration from Mathematics to Mathematical Literacy or vice versa.	Always	Often	Rarely	Never
11.1 Learners moving from Mathematics to Mathematical Literacy in Grade 10 and 11	1	2	3	4
11.2 Learners moving from Mathematics to Mathematical Literacy in Grade 12	1	2	3	4
11.3 Learners moving from Mathematical Literacy to Mathematics in Grade 10 and 11	1	2	3	4

SECTION C

This section explores your attitude and perceptions regarding Mathematical Literacy and Mathematics.

12. To what extent do you agree with each of the following statements? Please indicate by an**[X]** on your answer using the following 5-point scale where:

1. = Strongly Agree (SA)

2. = Agree (A)

3. = Neutral (N)

4. = Disagree (D)

5. = Strongly Disagree (SD)

	SA	A	N	D	SD
12.1 Doing Mathematical Literacy increases a learner's chance of getting a job	1	2	3	4	5
12.2 Doing Mathematics would be a waste of time for a learner's career that does not require Mathematics	1	2	3	4	5
12.3Learners who struggle with abstract problem solving in Mathematics can do Mathematical Literacy since it is not complex	1	2	3	4	5
12.4Learners must do Mathematics since it has more careers that they could study at the university	1	2	3	4	5
12.5Mathematics is difficult	1	2	3	4	5

12.6Mathematical Literacy is an easy subject since it focuses on general problems	1	2	3	4	5
12.7 Learners can easily pass Mathematical Literacy as compared to Mathematics	1	2	3	4	5

13. Please write down in the space provided what you think why is it important to do Mathematical Literacy/ Mathematics.

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Thank you for your co-operation in completing this questionnaire. Kindly return the questionnaire as specified in the cover letter.

APPENDIX C

INTERVIEW PROTOCOL

Interview duration: 30 min

Interview method: Semi-structured interview

- Focus question: What are teachers' views on the factors that cause migration of learners from Mathematics to Mathematical Literacy?

Question format: Open-ended questions

Response mode: Recorded by interviewer (Audio-tape)

Introduction: The purpose of this short interaction is to collect information on teachers' views about the factors that influence or cause migration of learners from Mathematics to Mathematical Literacy. Information gathered will be used by curriculum developers in the schools and Mathematics and Mathematical Literacy teachers. This interview will last 30 minutes. You may ask questions of clarity or raise concerns during the course of this interaction, you are most welcome to do so, feel relaxed. The aim of this interaction is to understand your views on the subject under discussion.

Questions

1. a) What is your understanding of Mathematical Literacy?

Probe: *How do you view the nature and scope of Mathematical Literacy?*

(b) What are your experiences in Mathematical Literacy?

2. What is the current subject you are teaching in Grade 10-12?

Probe: *Name the subject as per grade.*

3. How many learners of Mathematics and Mathematical Literacy does your school have in Grade 10-12?

Probe: *Particularly the grade you are teaching*

4. How are learners selected in Grade 10 for Mathematics and Mathematical Literacy?

Probe: *How do Grade 9 results play a role?*

5. Do you encounter a situation whereby learners move from Mathematics to Mathematical Literacy?

Probe: *if yes, what do you think could be the possible reason of learner migration from Mathematics to Mathematical Literacy?*

6. Do you think that learners pass Mathematical Literacy more easily than Mathematics?

Probe: *If so why, if not why?*

7. Does Mathematical Literacy have a wide range of career opportunities?

Probe: *According to your own experiences, why do you think so?*

8. According to Department of Education the purpose of Mathematical Literacy as a fundamental subject is to ensure that South African citizens become highly numerate consumers of Mathematics. From your point of view do you see Mathematical Literacy fulfil this purpose?

Probe: *How and/or why?*

Thank you for participating in the interview. Your responses are highly valued. I will let you have some information about the outcomes of the project.

APPENDIX D

LETTER OF CONSENT

Dear Participants

I would like to request your participation in an interview which I am conducting as part of my M Ed programme at the North-West University (Mafikeng Campus). The ***aim*** of the research is to determine the ***views*** of teachers and Heads of Department (Mathematics) on the factors that cause the migration of learners from Mathematics to Mathematical Literacy. The interview will be conducted in May/June 2013.

The interview will be reflective and will be based on individual views. With your permission, I would like to record the interview in order to capture the information accurately. The interview will take no more than one hour. Your identity will be protected and the information you give will remain confidential.

It is hoped that your participation in this research will make you more aware about the migration of learners from Mathematics to Mathematical Literacy.

If you agree to participate, please complete the slip below and return it to me. Please contact me (Ms.Thandeka Masuku, at 0791167399 or by email: tp.masuku@ymail.com

Thank you for your cooperation.

Yours Faithfully

Ms Thandeka P Masuku

I _____, hereby agree to be a participant of the research to be undertaken by Ms Thandeka P Masuku. I understand that the purpose of the research is to determine the views of the teachers on the factors that cause the migration of learners from Mathematics to Mathematical Literacy.

I therefore acknowledge that:

- the aim of the study, have been explained to me.

-I voluntarily and freely give my consent to my participation in such a study.

- I understand that results will be used for research purposes and may be reported in academic journals.

- I am free to withdraw my consent at any time during the study.

Signature _____ Date ____/_____/_____

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