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THE INFLUENCE OF ENGLISH AS A LANGUAGE OF LEARNING AND TEACHING ON HIGH SCHOOL LEARNERS' ACADEMIC PERFORMANCE IN MATHEMATICS IN VHEMBE DISTRICT

by

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April 2015

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DECLARATION

I, **LIVHUHANI CATHRINE MAKHUVHA**, hereby declare that the thesis entitled,

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is my own work and that it has not been submitted for any degree or examination purpose in any other institution or university, and that all the sources I have used and quoted have been indicated and acknowledged by means of complete references.

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DEDICATION

This thesis is dedicated to:

My late parents, Maluta Ernest Neluvhada and Thivhakoni Salphina Neluvhada, who raised and nurtured me as well as laid the foundation for my education. I am proud of my late father-in-law, Emmanuel Muthivhi Makhuvha, for his encouragement on educational matters. My husband Rembuluwani Daniel Makhuvha, my daughters, Tshinovhea Rejoice Makhuvha and Mulalo Elelwani Makhuvha and my son Khonani Emmanuel Makhuvha, for their encouragement and support throughout my study.

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ABSTRACT

The purpose of this study was to investigate the influence of English as a language of learning and teaching on the performance of learners in high school Mathematics. The main focus of the study was on how English as a language promotes the learning of Mathematics and performance of learners in the subject. The fact that English is used as a language of learning and teaching of Mathematics has been identified as a problem, since most of the learners and some teachers are not proficient in the language. A mixed-methods approach was employed in the collection of data. Quantitative and qualitative data were collected and analyzed. Four curriculum advisers were interviewed. Twenty-four Mathematics educators and 132 learners responded to the questionnaires. The empirical findings revealed that learners do not perform well in Mathematics due to their weakness in the English language. Learners fail to grapple with Mathematics as teaching is done in the English language. The study recommends that Mathematics teachers should synchronise the teaching of content and the development of English language skills. Furthermore, it was recommended that English teachers should be supportive in the development of Mathematics language skills. Of equal importance is that teacher training institutions should infuse programmes that help educators in the teaching of Mathematics in English as second language.

Key words: Academic performance, First language, Language of learning and teaching, Second language.

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CHAPTER 1

INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 INTRODUCTION

Language has always been a contentious issue in education in South Africa from the drive for mother tongue teaching to the ever pressing need to be able to use English as a medium of instruction (Olivier, 2009:17). Howie also (2003:1) asserts that South Africa faces a challenge of providing quality Mathematics education for its multilingual population. With the advent of a new democratic South Africa, eleven languages were allotted equal status in an attempt to alter the distribution of powers amongst language groups. Section 6(1) of the South African Constitution states that official languages are Sepedi, Sesotho, Setswana, siSwati, Tshivenda, Xitsonga, Afrikaans, English, isiNdebele, isiXhosa and isiZulu.

However, English is still the most dominant language which is used in almost all black public schools as a language of learning and teaching (LOLT) from Grade four up to tertiary level. In the same breath, Phaswana (2000:15) postulates that 96% of public schools in South Africa choose English as a language of learning and teaching after the first four years of schooling. Some public schools, however prefer a straight English approach from the onset of schooling. Statistics South Africa (2011:1) shows a lack of exposure of South African learners in general and the Limpopo learners in particular to English as a language of learning and teaching by home language as follows:

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Table1.1: Distribution of Limpopo and South African Population by Home Languages

	LIMPOPO		SOUTH AFRICA	
	N	%	N	%
Afrikaans	122 531	1.3	5 983 426	13.5
English	28 939	0.5	3 673 203	9.6
Isindebele	78 617	1.5	711 821	2.1
Isixhosa	14 225	0.3	7 907 153	16
Isizulu	34 358	0.7	10 677 305	22.7
Sepedi	2 750 175	52.9	4 208 980	9.1
Sesotho	69 370	1.3	3 555 186	7.6
Setswana	83 130	1.0	3 677 016	8
Siswati	57 703	1.1	1 194 430	2.5
Tshivenda	839 704	16.7	1 021 757	2.4
Sign language	-	-	234655	0.5
Xitsonga	1 180 611	17.0	1 992 207	4.5
Other	14 278	1.1	217 293	1.6
Total	**5 273 642**	**100**	**44 819 778**	**100**

Adapted from: Census Statistics South Africa, 2011:1

A large number of South Africans (22.7) as presented on the Table speak isiZulu as a home language (HL) at 22.7% of the population, followed by isiXhosa (16%), Afrikaans (13,3%), English (9.6%), Sesotho of Leboa (9.4%), Setswana (8%), Xitsonga (4.5%), Tshivenda (2.4%), isiNdebele (2.1%), and other languages only cover (1.6%) and sign language (0.5%). The situation shows that most black African learners are born in monolingual backgrounds in which they communicate in their mother tongue, but later on at school they are introduced to English as a second language (Dlamini, 2008:5).

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Census South Africa (2011:1) shows that English as a HL is very common in KwaZulu-Natal at 13.5% followed by Gauteng at 12,5%. It is followed by Western Cape where English is spoken by 19,3% of the population. In Vhembe District, where the research was conducted, the percentage of English speakers is at 0,5%. The situation shows that, South Africans have little exposure to mother tongue English speakers who comprise only 8,2% from whom they can learn English. In line with the setup, Probyn (2005:39) assets that over 80% of black African learners in both townships and rural schools have inadequate exposure to English outside the classroom. Learners are generally exposed to English when they watch television and play music. Similarly, Howie (2003:2) contends that English is the most used language by most learners for academic purposes although it is not widely spoken at their homes. Thus, the issue around the language policy for learning and teaching has become sensitive and controversial as it is in many other post-colonial countries. Schools are depicted as the most common domains where most African learners are likely to learn English. The situation, therefore, requires educators to pay intensive attention on the promotion of English as LOLT to enable learners to cope with their studies.

The poor state of English in South Africa is confirmed by the standard of LOLT literacy of learners who passed the National Senior Certificate (NCS) between 1990 and 2006. This is illustrated in Table 1.2.

The Table below shows that, from 1990 to 2006, the standard of learners' English proficiency has declined year after year. Even the best performance as reflected in 1990, was at 51%, which was unsatisfactory. It therefore, goes without saying that, we cannot expect learners to cope well in the subjects taught in English as a foreign language. Fouche (2006:3) attributes lack of proficiency in LOLT as a major factor that contributes to the poor performance of learners in other school subjects taught in English. Phaswana (2000:25) in his analysis of the language rights in the changing South Africa, argues that 74% of the population is not proficient enough to study in English. In the same breath, the Parliamentary Monitoring Group (2001:4) claims that, 40% of South Africans do not understand English. Dalvit, Murray and Terzoli (2009:40)

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also purport that only 25% of black South African learners have reasonable competence in English that enables them to pursue their studies. Fouche (2006:5) also assets that only 12% of urban black learners that completed Grade 12 in 2004 were functionally literate. It was further indicated that literacy levels of black postgraduate students was far below the expected Grade 12 level.

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Table 1.2: The Level of English Literacy of Grade 12 Learners

Year	N	% Functional Literacy
1990	568	51
1991	490	35
1992	898	33
1993	770	31
1994	930	28
1995	1314	25
1996	520	24
1997	434	22
1998	621	20
1999	537	19
2000	451	18
2001	676	16
2002	-	-
2003	491	15
2004	587	12
2005	642	11
2006	2998	15

Table 1.2: English Literacy Skills of Learners who Passed Grade 12 between 1990 and 2006

(Source: Adapted from**: Fouche, English language intervention in Multicultural tertiary environment in South Africa** (p3) by Fouche, 2006)

It is thus, deemed unreasonable and impractical to expect learners of a subject like Mathematics to study through the medium of first additional language (FAL). Second language learners have a double task of mastering LOLT and content simultaneously (Gerber, Engelbrecht & Harding, 2005:7). Furthermore, Le Roux (1993:105) asserts

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that, although English provides access to education and job opportunities, it is also an obstacle to learners who are not proficient enough.

Fouche (2006:8) argues that the use of English as a medium of instruction (MOI) necessitates synchronization of mastery of both subject content and LOLT. In the same note, Slavit and Slavit (2007:6) also argue that development of Mathematics register as a critical component of content understanding for both native speakers and first additional language learners is vital. They further point out that research on language acquisition suggests that Mathematics discourse and representations have features that make it difficult for English second language learners to draw meaning from the content.

In December 1995, a language group was commissioned by the Minister of Culture, Science, and Technology to investigate the possible measures in achieving the government's language policy objectives with regard to official languages. The findings revealed that learners' performance was affected by the use of English in examinations at school and higher education levels (Ngidi, 2007:2). Similarly, results were again reflected by the research team which was mandated by the minister to investigate the language issue with the assumption that, learners who write senior certificate examinations in a language that is not their mother tongue are seriously disadvantaged. The team concluded that language was a major factor contributes to poor results (Umalusi, 2004:12; Ministerial Committee, 1998:7). Horak and Fricke (2004:5) asset that Mathematics performance of black South Africans is weak and suffers from systematic problems linked to, amongst others, language of instruction.

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1.2 STATEMENT OF THE PROBLEM

The use of English as a medium of instruction has always been a challenge in Vhembe district. The situation trivializes the pressing academic performance that has persistently struck second language learners who do not cope well in their studies especially in Mathematics (DuToit & Roodt, 2007:90).

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It is striking that high school learners still reflect tremendous barriers that result in them having poor academic language proficiency required to master Mathematics. Thus, they fail to grasp even the most elementary fundamentals needed for mathematical discourses in class.

Most innumerate learners go through high school with a tremendous failure rate in Mathematics. The Mathematics diagnostic report of the National Senior Certificate Examination (2011:99) revealed that learners performed poorly since they struggled with questions which required interpretation, explanation or justification of answers. The Research conducted in Mankweng circuit in the Limpopo Province on the factors that contribute towards poor performance in Grade 12 mathematics revealed that learners struggle to communicate in English and that this is one of the factors that puts them at a disadvantage. Learners find it difficult to respond appropriately to examination questions in English (Rammala, 2009:21). There is also anecdotal evidence of learners who give up the learning of Mathematics and opt for Mathematical Literacy, which is perceived as less challenging (Department of Basic Education report, 2013:1). It is claimed that, over a period of 5 years, from 2010 to 2014, there has been an increase of candidates in Mathematical literacy by 30624 while Mathematics decreased from 270598 to 231180 (National Senior Certificate Report, 2014:29).

The linguistic deficiency of learners is exhibited in their constrained abilities in responding to Mathematics question papers. Horak and Fricke (2004:60) contend that languages of learning and teaching have serious repercussions on learners' performances. The Human Science Research Council (HSRC) Media Briefs (1998:1) reported that South Africa came last out of 22 countries which participated in Grade 12 Mathematics and Science studies in 1995. The outcomes of the test attributed underperformance of South African learners to lack of proficiency in English as a language of learning and instruction. In a similar vein, Howie (1999:209) reported the results of South African learners at the Third International Mathematics and Science Studies in which Grades 7, 8 and 12 performances were low compared to other countries. The reason is that, South African learners have to battle with English as a

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language of instruction. Neeta (2006:9) claims that learners cannot surpass the linguistic barriers via second language tuition unless deliberate intervention strategies are put in place.

Due to a high failure rate in high school Mathematics, higher education enrols a few students in the Science oriented fields. This has resulted in a shortage of manpower in professions that require a background in Mathematics. It is unfortunate that scientific careers are crucial to the economy and further development of the country. The forecast of this trend does not bode well for transformation and affirmative action in the Science industry. This study therefore explored the influence that English as second language and a language of learning and teaching exerts in the performance of high school learners in Mathematics.

1.3 THE PURPOSE OF THE STUDY

The aim of the study was to investigate how teaching Mathematics in English as a language of learning and teaching influences the performance of learners in the subject of Mathematics. The objectives of the study are as follows:

1.3.1 To determine the challenges encountered by learners when Mathematics is taught through English as LOLT;

1.3.2 To explore the attitudes and perceptions of educators towards teaching Mathematics in English;

1.3.3 To find out how proficient are secondary school learners in reading and understanding question papers during Mathematics tests and examinations; and

1.3.4 To assess the success of students in Mathematics at secondary schools.

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1.4 RESEARCH QUESTIONS

The main research question of this study is: How does English as a language of learning and teaching influence the academic performance of high school learners on Mathematics in Vhembe district? In order to answer the main research question, the following subsidiary questions were asked:

1.4.1 What challenges do learners encounter when Mathematics is taught through English?

1.4.2 What attitudes and perceptions do educators hold towards teaching Mathematics in English?

1.4.3 How proficient are secondary school learners in responding to Mathematics Tests and Examination question papers?

1.4.4 How successful are students in Mathematics at secondary schools?

1.5 STATEMENTS OF HYPOTHESES

On the basis of the purpose of the study and the research questions, I hypothesise that:

1.5.1 High school learners who are taught Mathematics in English experience learning difficulties.

1.5.2 Educators have positive attitudes and perceptions towards teaching Mathematics in English.

1.6 THEORETICAL FRAMEWORK

This study is grounded on the multidimensional theories which are pertinent to the teaching of Mathematics using English as a language of teaching and learning. Linguists present various perspectives in the advancement of the notion of effective teaching practice which yield good performance in Mathematics.

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The study is strongly is backed up by the notion of proficiency of learners on the basic communication interpersonal skill (BICS) and cognitive academic language skills (CALP), which are influential in the learning of content subjects. In an attempt to answer how proficient second language learners should be in using English for academic purposes, a number of researchers distinguish between basic interpersonal skills (BICS), and Cognitive academic language proficiency. They postulate that apart from BICS which is used for ordinary communication, CALP is a requisite for academic interaction in order to acquire knowledge and skills in subject content. This implies that BICS does not determine good performance in class, while CALP enhances cognitive development which enables learners to cope with their studies in English as a foreign language (Crandall, 1993:2; Crandall, 1994:86; Slavit and Slavit, 2007:3, Cummins, 2008:114). Slavit and Slavit (2007:3), Crandall (1994:86), and Yushau and Bokhari (2001:5) point that CALP is needed specifically for learners to effectively participate in Mathematics learning.

The threshold hypothesis was also adopted in the study. The threshold hypothesis advocates for the interdependence of home language and second language development in the content learning process. Jarret (1999:2) writes that, learners' home language plays an important role in Mathematics learning. It is further claimed that the use of home language in the learning process builds mathematical concepts. In a similar vein Nillas (2002:96) suggests that it is important for bilingual learners to be competent in both the first language and their second language to learn Mathematics better. It is, therefore of utmost importance for learners to be linguistically developed in both languages to enable them to cope in the study of Mathematics. Cummins (1981:9) also asserts that balanced bilinguals are more likely to perform well in Mathematics than monolinguals.

Furthermore, Thomas and Collier (1997:43), in their presentation on the acquisition of second language for school, claim that balanced bilinguals enjoy a cognitive advantage over monolinguals with regard to their performance in the subjects taught in the second language.

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The theory of comprehensible input was also considered relevant in the effective learning and teaching of Mathematics. The proponents of the theory contend that second language learners benefit from classroom instruction when they receive input that is comprehensible and a bit beyond their level of understanding while they concurrently master English (Krashen, 1985:2; Boals, 2006:6). The Virginia Department of Education document (2004:3) asserts that teachers should make their language comprehensible by modifying their speech in their lessons.

The three theories are complement one another in their recommendations about the effective learning of Mathematics in English as a second language and as a language of teaching and learning.

These three theories are crucial in this study as they outline language competences that learners should acquire to cope with the study of Mathematics in English as second language. The theories serve as guidelines that should be considered by education planners for effective curriculum delivery.

1.7 DEFINITION OF KEY CONCEPTS

This section deals with the operational definitions of the main terms that serve as a frame of reference for language used in this study. The clarification of the terms is meant to avoid the potential confusion that might arise due to misunderstanding.

Academic Performance: Melissa (2006:56) attributes academic performance to how learners deal with their studies and how they accomplish or cope with different tasks given to them by their teachers. Similarly, Ward, Stoker and Murray-Ward (1996:24) associate academic performance with academic achievement referred to as the outcomes of education which cover the extent to which a student, teacher or an institution has achieved their educational goals. Achievement is commonly measured in examinations or continuous assessment.

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In the context of this study, academic performance refers to how high school learners cope in a Mathematics class when they are taught in English as a second language and their proficiency in responding to question papers. It simply shows how learners meet the educational standards and how they fair in their studies in Mathematics.

First Additional Language: Collins English Dictionary (1991:218) interprets first additional language in terms of the order of learning as opposed to a first language. Hence, it is defined as a language other than the mother tongue that a person or the community uses for public communication, especially in trade, higher education, and administration. Similarly, Crystal (1995:368) defines first additional language as a non-native language, which is widely used for the purpose of communication, usually as a medium of education, government, or business. The study considers English as a second language, which is also used as a medium of instruction in the teaching of Mathematics in high school.

First Language: First language is defined as the main language that is first learned by mother tongue speakers and mostly spoken in the region or country (MacMillan Dictionary, 1997:243). Similarly the Free English Linguistic Dictionary (1989:159) defines first language as one's native language learned by children and passed on from one generation to the other. It is a synonym for mother tongue, the language first learned, best known or most used language.

Language of Learning and Teaching: The concept is commonly used interchangeably with medium of instruction and refers to a language used in the teaching and learning situation. Crystal (1995:197) and Richards (2007:225) define language of learning and teaching as a language used in education, which is commonly known as a standard variety of the main or national language of the country. In the context of this research, language of learning and teaching refers to English which is commonly used in the process of teaching and learning, as well as the language of examinations in high school Mathematics.

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1.8 RESEARCH PARADIGM, DESIGN AND METHODOLOGY

This section deals with the research approach, design and methodology adopted for the purpose of this study.

1.8.1 Research Paradigm

Research paradigm refers to a philosophical framework that guides the study (Corbin & Strauss, 2008:1). Maree (2007:47) describes a paradigm as a set of beliefs about elements of reality which give rise to a world view. The researcher understands it to be a philosophical basis which underpins a study. It provides lenses through which a research study can be viewed.

The choice of a research methodology is guided by the research paradigm that underpins a particular study. The following philosophical dimensions distinguish research paradigm: ontology, epistemology and methodology. Ontology refers to the theory about the nature of reality or what can be known about it. It is about the perception of what things really are and how they work together. Epistemology is the relationship between the one who knows and the known. Epistemology also relates to an understanding of the source of knowledge and how it is acquired (Huff, 2009:108; & Maree, 2007:48). Methodology is a research plan which lies behind the choice of methods used. It is concerned with the process and procedures in which data is obtained and analysed (Scotland, 2012:28).

These ontological and epistemological dimensions contribute to delineating research paradigms. The three main research paradigms are positivism, anti-positivism and critical theory, which in practice can take the form of pragmatism. This study adopted positivism and anti-positivism research paradigms, a combination which is known as pragmatism.

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Pragmatism advocates and values the use of both qualitative and quantitative designs (Denscombe, 2008:7; Creswell & Clarks, 2014:43). The combination or mixing of Qualitative and Quantitative methods, processes and procedures is encouraged, in order to have a deeper understanding of the phenomenon under investigation.

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1.8.2 Research Design

The study adopted a mixed methods design. The design adopts both qualitative and quantitative methods in a single study. Johnson, Onwuegbuzie and Turner (2007:119) define mixed methods research as a design in which the researcher collects, analyzes and integrates both quantitative and qualitative data in a single study or a multiple program of inquiry. In a similar vein, (Gray, 2009:204) defines a mixed methods as the collection and analysis of both quantitative and qualitative data in a single study. Thus data are collected concurrently or sequentially, and it involves integration of data at one or more stages in the process of research.

Many reasons can be considered for the use of mixed methods in a single study. However, for the purpose of this study, the researcher has considered four justifications for combining both methods in a single study adopted from (Creswell,1994:175 and Bryman,2006:106) as follows:

- Triangulation

Creswell (1994,:175) claims that triangulation seeks convergence of results of research. Bryman (2006,106) states that triangulation seeks convergence, corroboration of results from quantitative and qualitative data.

- Complimentarity

Creswell (1994:175) purports that overlapping of quantitative and qualitative methods and different facets of phenomenon may emerge through research process. On the other hand, Bryman (2006:106) is of the opinion that complimentary seeks elaboration, enhancement, illustration, clarification of results from one method with the results from another.

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- Initiation

It is claimed that initiation seeks to discover paradox and contradictions, new perspectives of frameworks, the recasting of questions or results from one method to another (Creswell, 1994:175 and Bryman, 2006:106).

- Expansion

Both Creswell (1994:175) and Bryman (2006:106) claim that, mixed methods approach extends the scope and breadth of enquiry to the study by using different methods for different components of enquiry.

The researcher also support Hesse-Biber and Levy (2006:307) who claim that combination of quantitative and qualitative methods create a synergistic research project whereby one method enables the other to be more effective and together both methods provide full understanding of the research problem.

1.8.3 Research Methods

The study adopted qualitative and quantitative methods in the collection of data.

1.8.3.1 Qualitative methods

The researcher used face to face semi-structured interviews to collect data. The interview was conducted with curriculum advisers to find out how successful the teaching of Mathematics through English as LOLT was in the schools.. The use of structured interview was preferred because they create a chance for the researcher to identify and correct the respondents' misunderstandings and to probe for inadequate or vague responses, thus enabling the researcher to gain meaningful data. Furthermore, semi-structured interviews were preferred because they allowed to establish rapport with and to motivate the respondents to answer questions accurately to improve the quality of data (Judd, Smith, & Kidder, 1991:218).

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Another positive aspect for using structured interviews is their flexibility, in the sense that additional questions may be asked as new issues arise. This can lead to gathering in-depth information (Gray, 2009:373). Furthermore, semi-structured interviews comprise of open-ended questions through which one can collect in-depth information by probing. Kumar (2011:150) also claims that in situations where in-depth understanding is required, semi-structured interviews are suitable for data collection.

The interview protocol was prepared to inform the respondents about the research details, the purpose of the study, how data would be kept and used, and the time allocation for the interview session.

1.8.3.2 Quantitative methods

Surveys, in the form of questionnaires, were used to collect quantitative data. Questionnaires were administered to high school Mathematics educators and learners. The use of questionnaire in this study, allowed for greater anonymity which helped to increase the likelihood of obtaining accurate information. Moreover, questionnaires afford ample time for the respondents to consider questions before answering. Furthermore, questionnaires elicit a large amount of information from a large number of respondents in a short period of time.

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1.9 SAMPLING PROCESS

This section addresses the population, sampling procedures and the sample.

1.9.1 Population

The population for the research was comprised of all educators who taught Mathematics in secondary schools, all secondary school learners who study Mathematics as a subject, and all Mathematics curriculum advisers in secondary schools in the Vhembe District.

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1.9.2 Sampling Procedures

The researcher used both qualitative and quantitative sampling procedures to select the respondents.

1.9.2.1 Qualitative sampling procedures

The researcher used convenience non-probability sampling in the selection of the respondents. This is a sampling technique in which subjects are selected because of convenient accessibility and proximity to the researcher (Berg, 2001:32). Thus, curriculum advisers were selected for inclusion in the sample because of their availability at the time interviews were administered. The sampling procedure was appropriate as the availability of curriculum advisers was not predictable. They are often deployed all over the district.

This sampling technique was considered because it is easy to carry out, and has few rules governing how the sample should be selected. Moreover, the relative cost and time required to select a convenience sample are reasonable. It, therefore, enables researchers to achieve the sample size in a relatively fast and inexpensive way.

1.9.2.2 Quantitative sampling procedures

Simple random sampling was used in the selection of both educators and learners samples. Bailey (1987:87) understands simple random sampling as a form of probability sampling in which all subjects in the population have equal probability of being selected for the sample. The sampling procedure was preferred because each individual has a chance to be selected. Hence, it permits generalization from the sample to the population it represents. The sampling procedure was adopted because it is simple and accurate in the selection of sample.

Four Mathematics educators were sampled from four big schools with an enrolment of over a thousand learners. However, two educators were sampled from small schools with less than a thousand learners. In situations where educators were more than the

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target sample, a lottery system was used to select the sample. Each member of the population at hand, was assigned a unique number. The numbers were then mixed thoroughly in a bowl. Then, without looking in the bowel, the researcher selected numbers. The educators whose numbers were picked from the bowl were included in the sample.

To sample the learners, a list of grade 11 and 12 learners was sought from the respective schools in Mvudi Circuit and this was used in the selection of the sample. The class lists were picked randomly. The researcher pointed randomly at the list to determine the starting point. Thereafter, numbers were picked at the intervals of 10. The process continued until 20 learners were picked from each big school with more than thousand learners, and 13 learners from each small school.

All learners who were registered for Mathematics in secondary schools had a chance to be selected. The researcher requested the target schools to provide her with lists of learners who were registered to study Mathematics. The names were arranged alphabetically and they were allocated numbers. The researcher picked the first number randomly. The subsequent participants were selected at intervals of 10 until the required number of participants was selected.

1.9.3 Sample

Both qualitative and quantitative samples were identified as follows:

a) Qualitative sample

Four curriculum advisers who play a supportive role in the teaching of Mathematics in Vhembe District schools were interviewed. Curriculum advisers are responsible for orientating Mathematics teachers to new teaching strategies. They also conduct in-service training and workshops for teachers, set and moderate assessment, compile year plans, and organise cluster meetings. They monitor written work and curriculum

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coverage. They insure that teachers have necessary support materials and encourage schools to share the resources and ideas, as well as compile and analyse diagnostic reports in an attempt to support teachers to improve the quality of teaching.

b) Quantitative sample

The quantitative sample comprised of 24 Mathematics educators selected from eight secondary schools in Mvudi Circuit and 132 high school Mathematics learners.

1.10 PILOT STUDY

A pre-test was conducted before the actual data collection with the informants who were not part of the main study to avoid pre-empting the information before the actual research. Sincero (2012:2) purports that a pilot study is a strategy used to test a questionnaire using a smaller sample compared to the planned sample size. Van Teijlingen and Hundley (2001:1) also assets that the term pilot study refers to a feasibility study which is a small scale version or trial run done in preparation for the major study. To encourage to conduct a pilot study prior to the main study, Van Teijlingen and Hundley (2001) state that a pilot study is vital and that, rather than taking risks, researchers should do it first.

The pilot study was conducted with the aim of pre-testing or trying out the questionnaire as a research instrument. It was meant to test the validity and reliability of the research instrument. One of the advantages of a pilot study, which was considered for this study is that it gives advance warning about whether the main research would fail, or whether the research questions can be followed, or the proposed methods or instruments are appropriate or complicated (Van Teijlingen & Hundley, 2001:1).

To ensure the internal validity of questionnaires, the pilot subjects were asked questions in exactly the same way as they would be administered in the main study. After administering the questionnaires, the subjects were asked to give feedback about the

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challenges they faced when they responded to the questionnaires. The respondents confirmed that the questions were clear and that there were no difficult and ambiguous questions. All questions were answered and they yielded an adequate range of responses. Thus, there were no contributions to improve the survey instruments. The researcher also recorded the time taken to complete the questionnaires and realised that, both educators and learners questionnaires, were completed in 15 to 20 minutes. The main study was allocated 20 minutes to complete questionnaires.

The pilot study questionnaires were administered to five educators from Sambandou circuit schools. The sample was randomly selected from five schools in the circuit. The lottery system was followed in the selection of one participant in each school. The names of educators were written on pieces of papers and put in a bowl. One paper was picked with the name of a participant.

Twenty-five learners from five high schools in Sambandou circuit were selected for the pilot study. The participants were drawn in descending order from the alphabetical arranged list of learners who were registered to study Mathematics. The first number was randomly selected between 1 and 10. The sample was drawn in intervals of 10 until five learners were drawn. I administered the questionnaire personally during study time in the respondents' class rooms.

Participants were informed that they were taking part in a pre-test phase. After administering the test, the respondents were asked to comment on the questionnaire, especially whether the instructions were clear and the standard of the questions. All respondents confirmed that they could follow the instructions and questions well. Furthermore, the researcher observed that 15 minutes allocated for both educators and learners' questionnaires was sufficient. The order of questions was eventually attended to and altered. The issue addressed was minor and there was no need to modify the questionnaires. Thereafter, the full scale survey was executed.

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1.11 DATA ANALYSIS

Data analysis was carried out both qualitatively and quantitatively.

1.11.1 Qualitative Data Analysis

Qualitative data was analyzed using qualitative content analysis. The approach was employed to analyse interview data. Hsieh and Shannon (2005:278) define qualitative content analysis as a research method for the subjective interpretation of the content of data through a systematic classification process of coding and identifying themes and patterns. Mayring (2000:2) argues that qualitative content analysis is an approach of empirical, methodological controlled analysis of text within their context of communication, following content analytic rules and step by step models, without rash quantification. The interpretive method was chosen because it pursues understanding of the phenomena. Kohlbacher (2006:6) defines qualitative content analysis as an approach to documents that emphasises the role of the investigator in the construction of meaning of a text. There is emphasis on the emergence of categories out of data and recognising the significance of understanding the meaning of text.

Content analysis was employed in this research because it allows the researcher to understand social reality in a subjective but scientific manner (Mayring, 2014:3). Another strength of the qualitative content analysis, relative to other interpretation methods, resides precisely in the fact that analysis is resolved into individual steps of interpretation, which are determined in advanced. Analytical steps make the whole analysis process comprehensible. Content analysis is also virtually unobtrusive and the materials needed for conducting research are easily and inexpensively accessible (Berg, 2001:258).

Weed (2005:10) defines interpretive analysis as an approach which focuses on interpreting life experiences of interviewees and on representing the world view from the interviewees' perspectives. Smith and Osborn (2007:53) claim that the aim of the

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interpretive method is to explore in detail how participants make sense of their personal and social world. The approach is said to be phenomenological because it involves a detailed examination of the participants' life world; it attempts to explore personal perceptions or accounts of events.

The interpretive approach was utilised because the presentation of qualitative content analysis results strives for a balance between description and interpretation of data. Interpretation represents one's personal understanding of the phenomenon under study. Sufficient interpretation allows the reader to understand the description.

1.11.2 Quantitative Data Analysis

Quantitative data were analysed through the Statistical Package for Social Sciences (SPSS) version 20 computer software. Data were analysed and the frequency distribution of responses were translated into percentages. SPSS was used in the generation of frequencies of the responses of both educators and learners. The frequencies were presented in the form of tables, graphs, and charts to simplify interpretation of data. The software was used with descriptive statistics. The null hypotheses tests were conducted with chi-square tests for validity of the questionnaires. The null hypotheses were either retained or rejected based on the significant level of the data.

1.12 MEASURES OF QUALITY CONTROL

Trustworthiness was considered as a measure of control for qualitative data. Validity and reliability was used to validate the instruments for quantitative data collection instruments.

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1.12.1 Trustworthiness

Trustworthiness relates to the rigour of the research study, which generates trust and confidence in the findings. It is a measure of the quality of research (Thomas, 2010:318). Trustworthiness includes credibility, transferability, dependability and confirmability.

- **Credibility (validity)**

Credibility refers to the validity of the study. It measures the extent to which the study measures what is actually intended. It is concerned with the accuracy of believability of outcomes of research (McMillan & Schumacher, 2010:102). To ensure credibility of the study, the researcher used the established mixed methods of data collection. The mixed methods added value to the triangulation of data. Furthermore, the right participants with relevant information were selected.

- **Transferability**

Transferability is concerned with the ability of the results of the study to be applied to other research contexts (Leed & Omrod, 2014:105). Thus, the results can be applied to a wider population. To ensure transferability, random sampling was used in the selection of participants. Moreover, the use of thick description in the analysis of qualitative data brought out comprehensive understanding of the phenomenon.

- **Dependability (Reliability)**

Dependability is the extent to which the results reflect the views of the participants and not those of the researcher (Thomas, 2010:315). The participants used in the study are knowledgeable. The selection of sites also ensured the collection of the right information. The use of a tape recorder also helped in member checking and confirmation of the transcribed data. The study also provided literature review on studies conducted by other researchers on same phenomenon. The researcher also provided evidence in the form of quotations or transcripts from interviews with

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curriculum advisers. The use of codes and themes on the transcribed data also helped in demarcating categories of data.

- **Confirmability**

Confirmability relates to objectivity of the study. It is the degree to which the research findings are the product of the form of enquiry (Babbie & Mouton, 2001:56). To ensure confirmability and for purposes of an audit trail - the researcher described the methods used in the study in detail. Moreover, the use of research assistants enabled the researcher to share views. This helped in the triangulation of data and prevented biasness in ideas.

1.13 VALIDITY AND RELIABILITY OF THE QUANTITATIVE RESEARCH INSTRUMENTS

Quantitative data were tested for validity and reliability of research instruments. Validity and reliability tests are regarded as primary criteria of evaluation in quantitative research. These two concepts are referred to as psychometric properties of research (Phelan & Wren, 2005:1).

1.13.1 Validity

Validity is regarded as the strength of conclusions, inferences, or positions, and refers to the extent we measure what we hope to measure and what we think we are measuring (Key, 1997:1). Content validity was used as a measure to test that the questionnaires measure what they were intended to measure. This was done by ensuring that every single questionnaire item was addressed by the literature review

1.13.2 Reliability

Phelan and Wren (2005:2) and Key (1991:2) define reliability as the degree to which an assessment tool produces stable and consistent results. The Cronbach's alpha test was

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conducted to check reliability of the questionnaire. According to Key (1991:2), the values around 0.7 and 0.8 are good for a reliability test. The reliability tests performed yielded between 0.7 and 0.8 values which are favourable.

1.14 DELIMITATION OF THE STUDY

The research was conducted in high schools, which are situated in Mvudi Circuit. Mvudi Circuit falls within Vhembe District in the Limpopo Province. The circuit covers schools in the CBD area of Thohoyandou and in the villages, for example Maungani, Gondeni, Malavuwe, Mbahe and Nweli. It is surrounded by Luvuvhu Circuit on the South, Vhumbedzi Circuit on the East, Sibasa Circuit on the West, and Mutshindudi and part of Sibasa Circuits on the North.

1.15 ETHICAL CONSIDERATIONS

To observe ethics pertaining to research practice, there is a need to seek permission from the district authorities to conduct research with the curriculum advisers. An application letter was personally delivered to the office before embarking on the research process. Furthermore, permission to conduct research in schools with learners and educators was sought from the manager of Mvudi and Mutale Circuits as well as the managers of the respective schools where the research was going to be conducted. The application letters were personally delivered to the offices by the researcher. Furthermore, ethical clearance was sought from the research and innovation office at the University of Venda.

The study upheld the research ethics of privacy and confidentiality, informed consent, anonymity, respondents' welfare and voluntary participation. The confidentiality norm is in line with Gray (2009:78) who claims the rights of privacy and confidentiality to be basic tenants in the democratic South African society. To achieve the requirements, questions were framed within the ambit of the target topic.

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An overarching principle which was observed involved providing the respondents with informed consent to be part of the study. Respondents were made aware that their participation is voluntary and they are in no way coerced into participating.

The participants were also assured that collected data would be kept safe in a locked cupboard to prevent other people, who are not involved in the study, accessing it. It was also necessary to apply a fundamental technique of removing identifiers, such as information on names, telephone numbers, e-mail addresses etc from data files. The names of schools and informants were replaced with pseudonyms to protect participants' identities.

1.16 SIGNIFICANCE OF THE STUDY

It is envisaged that the study will contribute to the literature on the use of English as a medium of instruction in Mathematics. The purpose of the study is to reveal the challenges that learners encounter when they study Mathematics in English, the attitude of Mathematics educators hold towards teaching Mathematics in English, the proficiency of secondary school learners in responding to question papers, and how successful Mathematics is as a subject. Moreover, the study came up with a model for teaching Mathematics in English as second language. The collected data will consientize learners, educators and curriculum advisers on the purpose of the study. The purpose of the study is to serve as a basis for improving the teaching and learning of Mathematics in English as second language.

The study might result in an increase of the learners studying the subject at school level, who will ultimately join Science orientated fields which are necessary for the economic development of the country. It is also hoped that the study will raise awareness of learners on the effects of studying Mathematics, and encourage them not to overlook English Language Proficiency in the learning of Mathematics.

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It is imperative for policy makers to review the effectiveness of the use of English as a language in learning and teaching in the school system. The findings of this study, therefore, will serve as a reference for those reviewing the language policy in education. Makgato and Mji (2006:254) also purport that, if South Africa is to participate in technologically advancing the global system, it is necessary for research to inform policy and drive transformation to a Mathematics and Scientific literate society.

Parents and school governing bodies (SGBs) are also beneficiaries to the study. Parents have an obligation to choose LOLT of their children on admission at school. The SGB is also mandated to come up with a language policy in their respective institutions. Through the input of the study, parents and SGBs will be empowered to take informed decisions on LOLT issues.

Of equal importance is that educators will have an opportunity to review their competences and effectiveness in teaching learners through the medium of English. Thus, the research input will enrich them with the knowledge on how to use LOLT in imparting Mathematics content. It is also anticipated that the research input will ultimately lead to the improvement of the teaching strategies and learners performance's in Mathematics.

As the study is within the ambit of teacher training and in service training, the study will encourage the institutions to review the synchronization of the language of learning and teaching with content in Mathematics.

1.17 RESEARCH OUTLINE

Chapter One of this research consists of an introduction that gives the statement of the problem, aims of the research, research questions, hypothesis, definitions of the key concepts and the organisation of the study.

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Chapter Two of the study focuses specifically on the literature review which covers theories of second language learning, educators' attitudes towards the teaching of Mathematics, educators perceptions towards teaching Maths in English, current set up in South African schools, teaching and learning of Mathematics through English in international communities, and the best practices of teaching and learning Mathematics.

Chapter Three reviews literature on the success of teaching Mathematics in English, the effects of the use of English as a language of teaching and learning, and methodologies of teaching Mathematics in English.

Chapter Four presents and discusses the research design and methodology.

Chapter Five of the study presents data analysis and interpretation.

Chapter Six comprises of a summary, limitations, recommendations and suggestions for further studies.

1.18 CONCLUSION

The focus of this chapter was to highlight the introduction and the background of study on which the whole study is based. The chapter provides an overview of the problem statement, the purpose of the study, the research questions and statements of hypotheses. The theoretical framework and the methodological foundations used in the study were also discussed in this chapter. Furthermore, the pilot study, data analysis and interpretation, delimitation of the study, ethical considerations, significance of the study and the research outline were also discussed.

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CHAPTER 2

EFFECTS OF THE USE OF ENGLISH AS LOLT IN THE TEACHING AND LEARNING OF MATHEMATICS

2.1 INTRODUCTION

This chapter discusses the use of English as a language of learning and teaching of Mathematics. It focuses on the theories of learning Mathematics in English as a second language. The chapter further highlights the strengths of the three theories, namely proficiency in Basic Interpersonal Skills and Cognitive Academic Language Skills, Threshold hypothesis, and Comprehensible Input hypothesis. Moreover the chapter discusses the models of teaching Mathematics in English. The recommended models are, the Zone of Proximal Development, the Second Language Approach to Teaching Mathematics and the Second Language Approach to Mathematics skills. The chapter also discusses on the status of teaching and learning of Mathematics through English in South Africa and globally, especially in the United States of America, Canada and Ireland. The chapter ends by focusing on the best practices of teaching and learning Mathematics in English as a second language.

2.2 CHALLENGES ENCOUNTERED BY LEARNERS WHEN MATHEMATICS IS TAUGHT THROUGH ENGLISH AS LOLT

In a study which was conducted among Xhosa learners in the Eastern Cape, Sepeng (2010:163) sought the educators' perceptions on the teaching of Mathematics in English. The study revealed that educators' are of the view that it is difficult to persuade learners to speak in English during a Mathematics lesson unless some coercive measures are applied to force them to participate. This implies that learners are likely to be withdrawn in class and they hardly participate in discussions due to lack of linguistic skills in the target language. As such, educators ultimately resort to the educator centred method in their class presentation. In most instances, both mother

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tongue and English are used concurrently in class. The educators in the study acknowledged that the use of both languages in class may trigger unique problems. Learners are likely to fail to understand the subject matter when a single word has multiple meanings in the subject content. Educators apply the use of both mother tongue and English to compensate for learners' limitations in the language. Hence, educators perceive the use of English as LOLT as a challenge for learners.

Another research was conducted by Pandian and Ramiah, with Grade 8 Mathematics educators in Malaysia, to find out their perceptions on the re-adoption of English as a medium of instruction. The change of medium of instruction from the mother tongue to English was meant to keep the country abreast with the scientific and technological developments in the world. The informants indicated that the change of policy was congruent with the development and understanding of English language learners. They indicated that learners found it difficult to cope in their studies because they were expected to learn in a language they were still learning. This was seen to be a formidable challenge as the proficiency and competency of English educators was voiced. It means that educators themselves were not proficient enough to teach in the language they were struggling with. Educators acknowledged that their colleagues who were not English specialists had a burden coping with the double demand of imparting both content and language (Pandian & Ramiah, 2004:3).

In the Malaysian study, about 76,1% of the respondents supported the switch to English as a medium of instruction because they regarded English as a language of knowledge in terms of Science and Technology. The respondents also indicated that it is of utmost importance for learners to be equipped with linguistic skills to access such knowledge. A few (22, 9%) did not agree with the move and the main reason they gave is that learners were not proficient enough and, as such, they could not follow lessons in class. The challenge was said to be worse in the rural areas where learners even struggled to understand simple instructions in English (Pandian & Ramiah, 2004:3).

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The respondents also pointed out that the challenge of textbooks which had inadequate examples and descriptions which were not suitable for English language learners. In other words, educators complained that learners could not use textbooks effectively as the language seemed to be beyond their understanding. Hence learners had to depend solely on educators' explanations to access Mathematics and Technology content. It is, therefore, not surprising that learners could not progress well in their studies and as a result, they underperformed (Pandian & Ramiah, 2004:3). There is also a belief that ELLs generally fail to understand textbooks and study guides. As such, learners experience challenges in solving problems in the textbooks. It was recommended that ELLs need to be familiarised with the language of different text discourses in order to deal with school subjects like Mathematics (Fillmore, 2007:338).

Furthermore, Mathematics educators admitted that it is their responsibility to teach learners the language of Mathematics. However the interview revealed that educators were not clear about the linguistic features of Mathematics content. This was advanced as a reason for educators failing to support their learners. Educators were unable to distinguish between Basic Interpersonal Communication skills and Academic Language proficiency that needs to be developed for learners to cope with Mathematics. Hence, a programme was introduced by the Ministry of Education to ensure that educators have some basic capacity to use English as a medium of instruction (Pandian & Ramiah, 2004:4).

In another study which was conducted by Ngidi, in Zululand, with secondary school educators, educators expressed that the use of English as a medium of instruction was daunting. The educators pointed out the frustrations they came across during lessons. Their frustration was ascribed to communication breakdown which is common during contact sessions. They claimed that this is due to a lack of exposure of learners to English since they encounter it in class only. Most learners came from families and communities which do not speak English. Moreover, learners had little or no access to books which can enhance their English language skills. Learners tended to feel out of place due to lack of communication skills (Ngidi, 2007:17).

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Educators also stated that they get frustrated when learners are unable to respond to questions in class. The classroom situation seems to be frightening to English language learners. Learners tend to be anxious unless they get help from classmates. This was attributed to the fact that English language learners are self-conscious and are afraid of making mistakes, which will make them and appear foolish when they try to express themselves in English. The behaviour of such learners is mostly characterised by aggression. When they fail to express themselves, they tend to be aggressive to other learners in class. ELLs tends to isolate themselves from other learners due to frustration. Such learners tend to memorise content, a sign that they have the potential to progress in school (Ngidi, 2007:18).

Considering the frustration encountered by learners in class, it was recommended that educators of ELLs should have knowledge of the learners' language and socio-cultural background. It was also advised that educators should have empathy, as well as tolerance for learners and support them to develop necessary linguistic skills (Ngidi, 2007:42). Even though there were challenges and frustrations associated with ELLs, educators still preferred English as a medium of instruction. They believed that English widens learners' horizons, while the mother tongue confines learners to their communities and cultures. In my view, both English and home language are of equal importance. They can supplement each other in the teaching of Mathematics. When learners fail to understand the Mathematics content in English, the home language can also be used to enhance understanding.

Fillmore (2007:337) also reports that educators believe that most learners who do not perform well in content areas lack proficiency in English as LOLT. Such learners experience challenges in understanding subject matter. It is claimed that a learner who has not learned academic register used in written texts finds language to be a barrier to learning any subject matter. In Mathematics in particular, it is believed that it is not an important feature in the teaching of Mathematics.

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This discussion reveals that, educators take Mathematics instruction in English second language as a challenging engagement which needs intensive support in order to surmount.

2.3 ATTITUDES AND PERCEPTIONS OF EDUCATORS TOWARDS TEACHING OF MATHEMATICS IN ENGLISH

This section outlines the attitudes and perceptions of educators towards the teaching of Mathematics in English.

2.3.1 Attitudes of Educators towards Teaching Mathematics in English

The attitudes of educators towards the use of English as a medium of instruction depends on the role they attach to it. Visconde (2006:4) is of the opinion that the attitude of educators towards the LOLT is reflected in class when they use it consciously or unconsciously. It is further stated that the attitude towards LOLT plays a crucial role in either growth or decay, restoration or its destruction. Webb (2012:9) asserts that, although there are 11 official languages in South Africa, the hegemony of English results in it being the most preferred language of learning and teaching. Despite the challenges that learners and educators encounter in the teaching and learning of Mathematics, in particular English, the language is still preferred. The reason is that English is regarded as a passport to social goods like having access to education, fulfilling jobs, and books written in English.

- **Access to Education and Fulfilling Jobs**

Sepeng (2010:22) asserts that educators are more concerned with providing the best instruction in English that would enable learners to access a high social status, higher education and prestigious employment. This reason was advanced to justify why Mathematics educators felt guilty depriving learners the opportunity to acquire proficiency in English.

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Similarly, Web (2012:9) claims that English is used as a medium of instruction to access education both at school and at tertiary level. English also opens opportunities for learners to access fulfilling jobs and positions of influence and power. Although the traditional views of power have had negative connotations, including oppression, control and authority, educators realise that the postmodern view is more positive since power is envisaged as being productive, creative, effective, and active as part of everyday life. Thus, learners who are proficient in English are regarded as being in control of their lives and have higher chances of surviving in the new democratic South Africa.

Webb and Webb (2008:206) argue that, despite the obvious disadvantage of using English only in the Eastern Cape Mathematics classrooms, educators still prefer it as LOLT. Educators are faced with not only teaching learners to be competent in English, but also acquiring Mathematics content in that language. English is considered a language of power and access to social goods which opens up doors for further education at tertiary level and for career mobility.

In a study conducted in 2008 with educators in multilingual township schools in South Africa, Setati (2008:1) found that all educators regarded English as the only choice in the teaching of Mathematics. The reason forwarded for the choice of English was that Mathematics examinations are written in English. She argues that question papers are prepared in English as a language of learning and teaching. The other reason they gave was that tertiary education is entirely accessible in English. Hence, educators' choice of English as LOLT was based on their awareness of 'the symbolic power it bestows on those who use it

- **Mathematics Books are in English**

Setati (2008:1) claims that educators are caught up in the preference of English as LOLT because most Mathematics books are written in English. However, she was surprised why educators do not question the reasons behind the writing of textbooks

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and the administration of Mathematics examinations in English rather than making use of other African languages. She is of the opinion that educators should have already registered the frustrations they encounter, in particular of learners who experience difficulties in understanding Mathematics due to lack of proficiency in English. This point creates an impression that educators are not vocal regarding the challenges they experience in teaching in English as a foreign language. The situation calls for further research on this aspect to extract latent information.

The researcher is of the opinion that, since English is an international language, educators should, by all means, try to cope with the pressure of teaching Mathematics in it. However, educators can register the frustrations they encounter in the use of English in the teaching of Mathematics. That should be done so that the Department of Education and researchers can come up with strategies to effectively teach Mathematics in English. We can also learn from developed countries how they are coping with the use of English as a second language in the study of Mathematics.

- **Challenges in Accessing Social Goods**

Dlamini (2008:6) argues that African learners have difficulties in accessing social goods due to low levels of proficiency in English as LOLT. The belief is endorsed by the belief that proficiency in the language of instruction is a factor in the acquisition of concepts and that this influences the degree of achievement. Thus, in cases where English is the medium of instruction, language proficiency determines the performance. The practice is said to be disadvantaging 60% of African learners and prevents them from participating in the development of their country as they have limited access to social goods.

In a study which was conducted by Setati, in South Africa, in which she explored how teachers and learners position themselves in the use of English in multilingual classrooms, it was discovered that they prefer English as they associate it with access to social goods and economic power. All six teacher participants stated ideological and

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pragmatic reasons for their preference of teaching Mathematics in English. The reasons ranged from the belief that English is an international language to the fact that textbooks, examinations, and higher education are all in English. Unfortunately, learners are still trying to develop fluency in the target language at this stage. However, the way teachers expressed themselves suggests that they did not want to take responsibility for the status of English. They see themselves caught up in the dominance of English. They feel that they do not have control because of the international nature of English. All they do is to prepare learners for the global world, and teaching Mathematics in English is an important part of this preparation (Setati, 2008:3).

Given the reason why educators prefer to teach Mathematics in English, it would be advisable for educators to, from time to time, check the success of this process. In cases where learners do not perform well, a review should be done to improve effectiveness in the delivery of content.

2.3.2 Educators' Perceptions towards Teaching Mathematics through the Medium of English

This section discusses the perceptions of educators towards teaching Mathematics through the medium of English. The presentation covers Mathematics teaching versus LOLT development and LOLT development responsibility.

- **Mathematics Teaching Versus LOLT Development**

Educators generally believe that Mathematics teaching and learning are language free engagements as reflected in several studies conducted in South Africa. This implies that leaning Mathematics does not involve proficiency in the language of learning and teaching. For instance, in a study which was conducted by Riordain and Donoghue (2006:6), they revealed that post graduate student educators fail to develop an association between proficiency in English as a language of learning and teaching and Mathematics understanding. One of them even stated that:

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> *"With Mathematics you do not have a huge element of language, even when you are writing it you are working it out in numbers and symbols, you are not working it out in Gaeilge or in English. So the actual physical working out of the problem is not done in a language"* (Riordain & Donoghue, 2006:6).

In other words, student educators, in this study, did not believe that language proficiency in LOLT impacts on Mathematics teaching and learning. They considered Mathematics teaching to be language free. It was also realized that the student educators' English proficiency was weak. The student educators confessed that they relied on the word for word translation of terminology and Mathematics questions in their mother tongue in the completion of tutorial sheets and examination questions during their first year of training (Riordain & Donoghue, 2006:6).

Student educators regarded learning the Mathematics register as mere learning of words and dissociated it from developing understanding of content in the target language. They also stated that learning Mathematics involved rote learning, which required them to go through Mathematics rules over and over again. Student educators further remarked that rote learning was hard and that it was difficult to remember learnt content (Riordain & Donoghue, 2006:7).

Jarret (1999:4) also assets that, traditionally, Mathematics has been thought of as a subject with a minimal language demand. However, Mathematics and language are intricately connected. The emphasis, nowadays, is on both problem-solving and communication to engage learners fully in the lessons.

In the researcher's view, student educators' disregard for language in the teaching of Mathematics was influenced by the impression they adopted from their respective schools. From the statements they uttered, one would deduce that they had some hardships in their studies since they relied on rote learning and translation of content from their home language to English. (Garegae, 2008:3) claims that translation is not

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reliable for there is a high possibility of misinterpretation of information. With rote learning, learners are likely to forget learned content and misinterpret questions.

Garegae (2008:3) reports that educators associate success in Mathematics teaching with development of ordinary conversational linguistic skills. Hence, educators often advise learners to read novels as a strategy to improve their fluency in English and to cope with Mathematics. The advice is based on the assumption that fluency in the English language guarantees successful achievement in Mathematics. However, Garegae (2008:3) argues that English used in mathematical speech is different from the one used in ordinary speech. This implies that, apart from ordinary English language proficiency, mathematical language skills should be developed to enable learners to cope with Mathematics learning.

- **LOLT Development Responsibility**

The South African National Curriculum Statement declares that, since English is used as LOLT, learners should develop proficiency that meets the threshold level necessary for effective learning across the curriculum. The proficiency includes abstract cognitive academic language skills required for thinking and learning. Educators were warned that learners may fail to understand academic concepts in the language they are still learning because their subject content educators are incapable of assisting them accordingly. As such, lack of attention to the teaching of functional language skills was considered a reason for learners' lack of academic achievement in Mathematics (Uys, van der Walt & van den Berg, 2007:70).

From the research conducted by Uys, Van der Walt and Van den Berg with four grade 8 Mathematics educators, the educators indicated that teaching of language skills is not their responsibility. The educators further argued that they expect language skills in the LOLT to be in place by the time learners reach secondary school. They claimed that they were only worried about completing the syllabus and that if they pay attention to the development of LOLT proficiency it would waste the contact time. Although the

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educators complained about the low levels of learners' language proficiency, they did not suggest any strategies to improve the condition (Uys, van der Walt & van den Berg, 2007:74).

In the research which was conducted by Sepeng with Xhosa learners and educators to establish the extent to which language aspects are addressed in the teaching of Mathematics, most educators claimed that they attend to linguistic aspects when they introduce vocabulary on the new topic. In the teaching process, educators write words on the board and ask learners to take turns explaining meanings. Thereafter the educator gives the proper meanings of the target vocabulary. The research findings revealed that educators were not applying any techniques to enforce understanding of new vocabulary.

Consequently, it was recommended that educators should optimise language teaching opportunities in content classrooms. It was further suggested that content subject educators should have special qualifications in teaching in English as a second language. It was suggested that the training should be in inclusive of language aspects, methodological issues and presentation skills. It was also suggested that subject educators should be awarded certificates after training when adeptness of language proficiency is satisfactory. All these suggestions were meant to force content subject educators to develop skills in the teaching of Mathematics simultaneously with the development of LOLT skills (Uys, Van der Walt & Van den Berg, 2007:74).

2.4 PROFICIENCY OF SECONDARY SCHOOL LEARNERS IN RESPONDING TO MATHEMATICS QUESTION PAPERS DURING EXAMINATIONS

Learners' proficiency in Mathematics is rated by assessing the quality of responses in examination question papers. In this study, the researcher assessed the quality of responses in the Third International Mathematics and Science Studies (TIMSS), the performance of Grade 12 learners in Mathematics and the three theories on the acquisition of Mathematics in English as second language. The theories discussed are

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the Proficiency in Basic Interpersonal Communication Skills and Communication Academic Language Proficiency, the Threshold theory, and the Comprehensible Input theory.

2.4.1 Performance of High School Learners in the Third International Mathematics and Science Studies (TIMSS)

The Newsletter for International Studies (1998:3) has noted with great concern that every country's education system is entrusted with the task of imparting knowledge, abilities and values which have to be carried out by schools through teaching and learning. Solid training in Mathematics in particular is regarded by an increasing number of countries as an investment in future technological and economic development. Countries, from time to time, observe the level of performance of their school system with the long term goal of optimising educational processes. International comparisons provide opportunities for countries to evaluate the quality of their education systems.

South Africa, like other countries, participated in the Third International Mathematics and Science Studies (TIMSS). TIMSS is a series of international comparative school of achievement studies which have been carried out by the International Association for the evaluation of educational achievement since 1959. The achievement tests are diagnostic tools that lay bare weaknesses and challenges of the education systems of countries which are involved. The TIMSS research focused on finding out the opportunities provided for learners in the learning of Mathematics and how instructional practices in Mathematics vary among nations and factors that are linked to learners' opportunities to learn in class (The Newsletter for International Studies,1998:5).

Howie (2003:204) reported that the matriculation results of South African learners in ordinary Mathematics were unsatisfactory. The worst part is that South Africa did not participate in specialised Mathematics. The TIMSS research findings also revealed that teaching practice in classes was not effective.

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Howie (1999:209) states that the results of South African learners who took part in TIMSS were received with a shock and dismay by the broader community. The overall results for Grade 7,8 and 12 were very low compared to those of other countries. South African learners experienced a number of problems. Amongst other challenges, South Africans had to battle with the language of instruction where Mathematics is taught in second or third language.

Horak and Fricke (2004:1) assert that the International benchmark studies confirm that the education of Mathematics in South Africa schools is weak and suffers from systemic problems. Hence, an appeal was made to given all possible support to promote Mathematics teaching and to attract potential learners to engineering studies. The report revealed that the South African Grade 12 learners obtained a significantly lower average score (352 points) than the other participating countries for which the international average score was 500 on a scale of 800 points.

The HSRC Media Briefing (2004:1) reports that South Africa was one of twenty two countries that participated in a Mathematics and Science study in 1995 that was conducted with Grade 12 learners. Two thousand seven hundred and fifty-seven learners were tested for their general Mathematical knowledge and in particular for their reasoning and problem solving skills. The outcomes of the tests revealed that South African learners underperformed because of lack of proficiency in English as a major factor. South Africa, therefore, came last in the international study.

The HSRC Reviews (2011:9) also presented a gloomy report on the TIMSS study that South Africa participated in, in 2002 which involved 50 countries. The results reflected that the schools categorized as well resourced and better performing were from the house of assembly and the House of Delegates which managed to perform at the international mean level while black South Africans were far below the international mean.

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The pathways and performance in Mathematics of secondary school learners in South Africa was analysed using a panel-like data of Grade 8 learners that participated in the 2002 trends in international TIMSS who were tracked to the Grade 12 examination data. The relationship between TIMSS Mathematics performance and reaching Grade 12, the selection of and performance in Grade 12 Mathematics, and the success rates in matriculation examination were realized. Mathematics achievement scores in South Africa were low and different performance patterns were shown between subsystems. It was noticed that Mathematics performance in Grade 8 predicted the latter performance in Grade 12. The results led to the conclusion that Mathematics concepts should be imparted earlier in Grade 8 to prepare learners for the complex content in Grade 12. This posed a challenge for the Department of Education to come up with the strategies to close the conceptual gap (Vijah, Servaas and Van Rensburg, 2012:12).

The EERA Networks (2010:4) reported on the performance of learners who participated in Benchmarking Mathematics studies. The report indicates that the studies were used by participating countries to gauge the quality of their future prospects in engineering and technological studies. The trend reflected that South African learners were the worst of all participants in 1995 and 1998. The analysis revealed, amongst others, the systemic problem and issues linked to language of instruction and learner specific socio-economical situations linked to the teachers' attitude towards Mathematics teaching and learning. The competence factors which relate to language of tuition were identified as follows:

- Learners who spoke either English or Afrikaans at home achieved higher scores than those who did not.
- The Language of learning in the classroom was found to be a significant predictor of achievement of learners in South Africa.
- Second language learners from other countries performed better than top performing South African learners;
- Learners do not perform well in Mathematics Grade 12 because they often have a poor background in the primary school;

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- Few learners pass each grade and most of them are promoted with poor Mathematics marks and that educators are bitter about this and they do not take control of the situation in the next grades. Instead they just teach learners assuming prior knowledge which is not there;
- When educators arrange extra-lessons, very few learners attend;
- Some teachers are badly affected by the situation as they tend to be unhappy that they are teaching underachievers and ultimately become demotivated with their teaching;
- Some teachers were found to have a poor teaching style, for example some teachers spend the whole lesson writing copious notes on the board, while learners are copying them down. No real teaching is done;
- Some teachers have a haphazard approach with little or no preparation and planning;
- Most schools experience a problem of learners who are promoted to higher grades without basic skills necessary to master mathematics content; and
- The top learners who receive public accolades in Mathematics often experience some difficulties in coping with the studies at tertiary level.

These are the challenges that prompted the researcher to undertake this study. The education system will not be effective if such challenges are still experienced.

The HRSC media briefing (2004:1) also reported on the 2003 TIMSS in which South Africa also participated as one of 50 countries involved. The report showed that Asian countries such as Singapore, Republic of Korea, Hong Kong SAR and Chinese Taipei were top performers. The results revealed that there was a vast difference in the performance of learners among provinces in South Africa. The Western Cape, Northern Cape, and Gauteng were the three top performers. The three lowest performers were Kwazulu Natal, Eastern Cape and Limpopo. The top performers had almost twice the scores of the lowest performing province. The Northern Cape showed the highest improvement in the scores in comparison with TIMSS 1999. The most worrying factor is that Limpopo, where the research was undertaken, was depicted as one of the weakest

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provinces. The situation should encourage researchers to conduct research to address these challenges.

The analysis of performance of learners, according to categories, indicates that learners in African schools had the lowest scores than learners in the former white schools had scores just below the international mean (The HRSC Media Briefing 2004:1). Furthermore, the performance, according to languages, showed that learners who took the test in Afrikaans scored higher than learners who took the test in English which is their second language. Learners who took the test in Afrikaans came mainly from the Western Cape, the province with the highest scores. The performance was attributed to, amongst other factors, language proficiency in which the issues of conceptual and cognitive demands were placed on learners in classroom seem to be significant (The HSRC Media Briefing, 2004:3). The situation clearly reveals that learners who use the second language as a medium of instruction in Mathematics are likely to have some learning difficulties unlike those who use a home language.

Leong (2009:4) assets that South Africa did not fare well in TIMSS because the tests were administered in English as a Language of learning and teaching. He attributes the poor performance of learners on language factors and deficiencies in the teaching approaches. A similar situation was cited by Leong in which learners at primary, secondary and tertiary levels in Brunei face the same dilemma. The majority of learners underperformed in written public examinations administered in English. The drawback in examinations was attributed to language factors and it was reflected in examiners' reports (Leong,2009:4).

It is argued that language remains one of the dominant factors that influence pupils' poor performances in Mathematics, especially if the questions are wordy. Moreover, if learners are not fluent enough to read questions and express themselves in the LOLT, they find it difficult to answer, especially, inference questions. It is further claimed that the same challenge is experienced by learners who can express themselves in LOLT, but find it difficult to respond to inference questions (Leong, 2009:9).

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In an attempt to respond to challenges which learners encounter when responding to examination questions, it is advised that Mathematics teachers at all levels of education, provide second language learners with many opportunities for guided and independent practice which should be done as a co-curricula activity (Leong, 2009:10). Further claims indicate that teachers, at all levels of education, are expected to provide learning with a deep understanding for transfer of knowledge to varying types of questions in order to achieve good results. To achieve the answering skills, teachers are urged to expose learners to more opportunities of building conceptual relationships and encouraging active and co-operative learning. In this context, investigations, explorations, and discussions of Mathematical ideas need to be carried out. Research also shows that, it is vital for educators to ascertain that learners understand the concepts learned (Leong, 2009:5).

The situation in South African Mathematics is worsened by the fact that there are some challenges for learners in what are described as performing schools. Their scores in international tests such as TIMSS show that South Africa is not globally competitive. Moreover, the Southern Consortium for monitoring Educational Quality (SACMED) results shows that learners from South Africa's top-performing schools are outperformed by other African countries with lower Gross Domestic Products (HRSC Review, 2011:3). It is really striking that the country is not investing on the expenses incurred in education.

2.4.2 High School Performance in Mathematics Examinations Versus LOLT

The influence of English as a language of learning and teaching on high school Mathematics was analysed to find out the challenges experienced by learners in the learning process and the results thereof.

In a seminar that was held in 2007 on the quality of education, the report presented by Professor Fleischer revealed the factors that led to the underachievement of South African learners, for example health issues, poverty and on language of learning. He

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indicated that the South African language policy needs to put aside the emotions of second language teaching and take into account the fundamental shifts taking place regarding the status of English as a language of learning and teaching. The issue of concern was how English is used in the classroom since it has an impact on the competence of learners. Professor Fleisch concluded by saying that more research needs to be conducted on the intervention strategies required to improve what happens in classroom (Umalusi, 2007:2).

Dr Lowland, in a 2007 seminar, highlighted the language challenge in South Africa and other Anglophone countries. She indicated that, although English is used as a medium of instruction by almost 82% of the learners in the Senior Certificate, South African learners continuously display challenges. She made reference a research carried out by to Umalusi in 2004 which revealed a weakness in the performance of second language learners in the senior certificate examination. About 50% of the learners on average achieved less than 35% in the subjects offered in English in the past five years. Even with easy and undemanding subjects, learners are still scraping through in examinations. The situation was attributed to learners' weakness in English. (Umalusi, 2007:3).

Dr Lolwana centered her presentation on what is good education was about. To her, good education has to do with the enhancement of cognitive skills through the learning process. She purports that learners should be able to use English to access underlying cognitive abilities such as articulating ideas and arguing. She even argued that there is a small pool of learners with these cognitive skills. She pointed out that this vision of education has not been adequately understood across the South African nation. She then suggested that the curriculum should be set as an important vehicle for good education with effective language pedagogy as an important condition to support good education in which learners will be able to perform at maximum levels of competency. She further indicated that, teacher development and continued teacher professionalism need to be prioritised. She also reckons that the pedagogies of English as second

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language need to be taken seriously so, established and be implemented if we are to improve the quality of education (Umalusi, 2007:22).

In his presentation, Professor Fleisch shared the same sentiments with Dr Lolwana concerning the causes of underachievement of South African learners. He, amongst other things, also made reference to language and learning as important issues contributing to low quality of education. He indicated that, with regards to language policy South Africans need to put aside the emotions of second language teaching and take into account the fundamental shifts taking place regarding the status of English as a language of learning and teaching. He argued that the language issue should focus on how English is used to develop learning through the curriculum. He further argued that more research needs to be conducted on the intervention strategies to improve the teaching approaches to improve learners' performance.

Umalusi (2004:4) report revealed that the first Grade 12 examination results following the enactment of South African School's Act in 1996 were extremely poor. Evidence provided for the underperformance was associated with learners' inability to cope with the pass requirements especially with gateway subjects like Mathematics. Following the incident, the Minister of Education appointed a research team to investigate the language issue in 1998 with the assumption that learners who write senior certificate examination in a language that is not their mother tongue are seriously disadvantaged. The team confirmed that LOLT (English) was a major factor contributing to poor performance by learners.

In 1999, the South African Certificate Council (SAFCERT) decided, as part of its responsibility to ensure fairness in the senior certificate examination, to introduce compensatory measures for learners whose first language was neither English nor Afrikaans. Such learners were allocated 5% compensation in content subjects. The mechanism was implemented as an interim measure while the provincial departments sought to upgrade the teaching and learning of English as a second language and a language of learning and teaching. However, it was shocking that the statistical

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analysis revealed that the competency levels of compensated candidates in second language have not improved over the seven years of its implementation. The cognitive and proficiency demands for learners to cope with the subjects offered in English as LOLT were found to be far much below the standard (Umalusi, 2004:5).

It was then suggested that, to be successful, the teaching and learning of Mathematics in English as a second language in further education should supported by adequate mother tongue instruction in the early grades. It is believed that learners who are taught to effectively use their mother tongue do not find switching to a second language challenging (Umalusi, 2004:9). The researcher also shares the same sentiments that learners should have a strong background in their home language so as to be effective in the use of English as a language of learning. When learners fail to grasp the content in English, further explanations can be done successfully in the home language.

Reyneke, Meyer and Nel (2010:23) express a serious concern about learners in the Further Education and Training band who cannot read, write and comprehend English at their grade level. The situation is unfortunate in that English is used as a medium of instruction and this negatively affects the performance of learners in all learning areas. This problem was attributed to the lack of basic English language skills. Moreover, it is claimed that, assessment is designed to allow learners who cannot read, spell or write to pass the subjects and progress to the next class when they are not ready.

Fisher and Scott (2011:12) also reported on the deep seated failings by South African children throughout the school system. He claimed that the situation has been worsened by the new national curriculum introduced in 2008. Performance in subjects like Mathematics, Engineering and Technology subjects is declining. The report also revealed that results of the higher education in the South African National Benchmark tests suggests low levels of preparedness by learners in Mathematics. The assessment is supported by qualitative studies of first year students' performances in various subjects. The critical issue was more on the quality rather than the number of passes

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that involved the underlying knowledge and skills or academic preparedness of students entering higher education (Fisher and Scott 2011:12).

The Mathematics and Science in Limpopo Report (2001:4) revealed that Grade 12 learners in the Limpopo Province in particular (where this study is conducted), produced the poorest or second poorest matriculation Mathematics results out of nine provinces for five years in succession. The report also revealed that South African learners do not perform well in Mathematics internationally and locally and that the situation is even worse among black learners. The failure rate for black Grade 12 learners in Mathematics in 1999, 2000, 2001, 2002 was at 88, 3%, 84, 5%, 80% and 76, 8% respectively. The data showed that the number of higher grade Mathematics passes for black learners was around 3000 per year at most. The pass rate was disturbing because this was the pool from the black population that served as a source for tertiary institutions, and for graduates in the Sciences, Engineering, Technology and Mathematics professionals among black population (Mathematics and Science in Limpopo, 2001:2).

The findings presented by the National Commission also concur that there is a gloomy picture in Mathematics in the South African education system. The report revealed that the state of Mathematics affects the quality and the quantity of human resources for the nation as a whole. The underperformance of learners in Mathematics has serious implications for higher education institutions where lecturers complain about the influx of Mathematics incompetent students. The problem identified includes the poor presentation of the subject matter, and the inability of learners to cope with Mathematical language. Fortunately all these are school-related variables that can be addressed (Mathematics and Science in Limpopo, 2001:3, hence the need for this research.

Furthermore, the HSRC Reviews (2011:20) claim that the national average Mathematics achievement scores for different grade levels across the schooling system is similar and stable, around 30% and 40% at different grades. The performance of

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learners, in this regard, reflects badly on South African education system. It transpired that, when we evaluate high skill capacity in the country and active participation in the knowledge economy, Mathematics skills are very important. Thus, high skills and the economic knowledge are rated as a very high potential. This implies that since South African learners show a very low standard in Mathematics, it is rated low and incompetent.

The Department of Basic Education Report (2013:1) and the South African Government Information (2012:1) argue that there has been a bit of improvement in Mathematics performance between the period 2009 and 2012 from 39,6% to 44.4%. However, the improvement was not exciting, for the performance was still under the national norm of 60%. However, Dinaledi schools were much better, for instance, Limpopo, Gauteng and Free State were at 61% and they came first. Even the independent schools had performed well above the national norm. Another upshot of the situation is that it is believed that the reason why performance improved was because of a shift from the harder Mathematics to easier Mathematical Literacy from 2009 to date. Unfortunately, Mathematical Literacy is not considered for Mathematics orientated fields that the country needs to develop the economy of the country.

As part of the 2013 priorities, the Limpopo Department of Education has established a Mathematics and Science task team to identify challenges in the teaching of Mathematics and Science. This task force worked hand in hand with the provincial departments to address the challenges (Department of Basic Education Report, 2013:3).

It was recommended that there should be a strong correlation between Grade 8 and 12 Mathematics achievements which should be established if we are aiming for furtherance of learner's performance. The relationship of performance in these grades corroborates the findings from literature that the quality of Mathematics basic skills acquired in lower classes has a direct impact on one's performance in high grades. This means that Mathematics knowledge is hierarchical in nature and, therefore, a strong

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prior knowledge is critical for conceptual development. The acquisition of these capabilities is shaped in the early years by the quality of interactions learners are exposed to in the classroom, home and the community at large. It is thus imperative that learners should know and understand the earlier concepts and only when they do should they progress. The findings show that it is too late to try to improve Mathematics performance only when learners reach the secondary level. It is further claimed that effective teaching requires an educator who understands how teaching should be effectively conducted in English (SANGO Net Pulse, 2011:1).

It also transpired that enrolments in Mathematics and matriculation exemption varies dramatically among ethnic groups in South Africa. While only 1 in 312 black learners entering the school system leave with Mathematics in the final year, 1 in 5,2 white learners, 1 in 6,2 Indian learners and 1 in 45,9 coloured learners obtained a matriculation examination with Mathematics. In 1993, the figures show that only 26% of all black learners took Mathematics compared with 37, 5% of all white learners. However, of these numbers, only 25% of black learners passed their final Mathematics examinations compared to 95% of white learners (Howie, 2003:1). In my opinion, white and coloured learners outperform black learners because they are taught in their mother tongue, and tests are written in the mother tongue as well.

The Department of Education Report (2001:2) presents poor output of Mathematics in Grade 12 in South Africa between 1997 and 2000. The Table below reflects the performance statistics thereof: The pass percentage in higher grade between 1997 and 2000 was at 4.1%, 3.7%, 3.9% and 3.9% respectively. The standard grade passes were also not an exception at 12%, 12.4%, 14.1% and 16.2% respectively.

Furthermore, an analysis of the year 2000 senior certificate results revealed that, out of a total population of over 400 000 candidates, only 20 243 African candidates wrote Mathematics in the higher grade, and of those who wrote only 3128 passed.

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The performance in the higher grade was better in the Western Cape, Northern Cape at 36% and 75% respectively where the population is predominantly made up of Afrikaners who use Afrikaans (their mother tongue) as a medium of communication. Gauteng was also better at 41% because the province is made up of mixed learners who are exposed to English which is predominantly used as a medium of instruction. This impacted positively on learners' performance. The rest of the other provinces use English as a medium of instruction which is a second or even a third language in the provinces. The same unsatisfactory performance is reflected in standard grade level Mathematics.

The Department of Education Report (2001:16) attributes the underperformance of learners in Mathematics, amongst other factors, to the use of English as a medium of instruction is different from the learners' home language. It is further purported that, although language problems reflect insufficient conceptual understanding, difficulties associated with the learning and teaching of Mathematics are also associated with lack of proficiency in the medium of instruction. It is, therefore, recommended that the education system should strengthen the development of LOLT and Mathematical discourses simultaneously.

Horak and Fricke (2004:1) also raised a serious concern about the small pool of students in scientific orientated professions such as engineering disciplines like mechanical, electronic and computer engineering. They claim that the challenge is not only attributed to Grade 12 pass figures that have declined steadily in South Africa over the years, but to the proportion of learners with Mathematics at a higher grade, which has remained very low. Another worrying factor is that, passing with acceptable symbols for admission to studies in engineering at universities, is even less and the demographic distribution is still heavily biased towards white learners. The engineering profession is under tremendous pressure to transform and reflect South African demographics and grow the small pool of Mathematics, in order to prosper.

Du Toit (2007:92) revealed a racial breakdown of Mathematics passes for the years 2002 and 2005. The results revealed that, although African and coloured learners who

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wrote Higher Grade Mathematics increased quite substantially, their pass rate remained below those of Indian and white learners. In 2005, African learners achieved a pass rate of 38% and coloured learners obtained 74,0%, Indians 90,2% and White learners 94, 7%. Thus the performance of learners was in hierarchical order with the privileged obtaining higher pass rates. The results followed the status of races in line with the belief drawn by apartheid regime.

The HSRC (2011:21) also revealed that, the underperformance in Mathematics continues to be low even with many intervention strategies which seem to be unable to effect changes. Using the findings from the HSRC paper where a panel was set to examine the extent of association between Grade 8 Mathematics and Grade 12 performances shows a strong correlation between learners' achievements. The correlation of scores corroborate the findings from literature that earlier performance and strong foundational knowledge determines subsequent learning. Mathematics knowledge is hierarchical in nature and, therefore, a strong prior knowledge is critical for conceptual development. Conceptual framework can be built by the quality of input in Mathematics classroom. If learners are to succeed in their studies, they should understand earlier concepts. Findings show that it is too late to improve Mathematics performance when learners are already at secondary level. The improvement at secondary level is only possible when the teacher understands appropriate strategies of learning and teaching Mathematics (HSRC Reviews, 2011:22).

I concur with the argument that the foundation of Mathematics concepts should be built when learners are still in lower grades in the primary section. Without a firm foundation, learners require extra tuition to close the content gap.

The Politics web (2012:1) also claim that the high dropout rates in Grade 11 and 12 are largely due to the fact that learners do not acquire the foundational skills they should have acquired in earlier grades at school level. Learners are likely to dropout just before finishing Grade 12. However, those who manage to get to matric carry their learning deficits with them as they would have been pushed through the grades only to fail in

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Grade 10, 11 and 12 since schools do not want high failure rates. It is estimated that 80% of the poorest South African schools, only 1% of the learners in Grade 8 pass through the system and pass Grade 12 with symbol of C or higher and overall pass percentage and 60% in Mathematics. Approximately 10 times as many learners reach this level in the wealthiest (20%) schools. Looking at the differences by race, in 2007 just over 1% of all black Grade 12 candidates qualified for admission to Mathematics and Science degree programmes, compared to 15% of their white counterparts.

Given that less than half of the grade one black cohort actually make it to matric, we can infer that only two hundred black children enrolled in grade one went on to pass grade 12 and were eligible for Mathematics degrees (Politics Web, 2012:2). In addition, Solidarity Research Institute (2008:3) presents disappointing Grade 12 Mathematics results. The pass rate of higher grade Mathematics was reported at 7% and for standard grade at 46%. The total pass rate translates to 54% out of a total of 347 570 learners. The higher grade pass rate leaves much to be desired in so far as quality of performance is concerned. This implies that all the higher institutions and the work force had to share 25 415 students who passed Mathematics with a higher grade (Solidarity Research Institute, 2008:3).

In my view, most learners who drop out of school are weak in Mathematics. Furthermore, there is a trend of learners choosing standard grade over high grade Mathematics. Nowadays, the trend has shifted to change from Mathematics to Mathematics literacy. The most worrying issue is that, learners who do Mathematics literacy exclude themselves from Science orientated professions like being doctors, engineers, and so on which are important for the development of the country.

The John Templeton Foundation (2009:18) asserts that, at every stage of education, more learners in Africa drop out of Mathematics and this situation badly prevents education systems from producing their own future labour force. It has also been noted with regret that both primary and secondary level Mathematics education is weak and in most South African countries reducing the potential population of talented students who

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choose Mathematics as a major course at university level. Hence, the situation puts South Africa in a state of educational crisis characterised by a widespread shortage of teachers and poor delivery of Mathematics, which is said to be worse in the rural areas than urban centres.

The researcher concurs that, South Africa has a crisis in education because of the dire shortage of professionals in scientific fields. For instance, in teaching it is no longer easy to get Mathematics educators. Hence, the country depends mostly on foreigners. The Department of Education is doing everything it can to provide the programmes to recruit learners to register in the scientific fields. In the Limpopo, there is the Funzalushaka and Limpopo bursary for educators. Learners receive comprehensive funding as a way of motivating them to join the field. There are some funding programmes in the field of health as well. The department has realized that learners have no interest in scientific fields. This emanates from the negative attitude towards Mathematics which learners believe is a difficult subject due to the use of English as LOLT.

Reyneke, Meyer and Nel (2010:1) also argue that learners in the Further Education and Training band (FET) are illiterate because most of them cannot read, write and comprehend English. They also report that most people blame the outcomes based approach for this problem. The challenge is attributed to the fact that learners generally lack basic language skills in English which is the LOLT. Hence, the assessment is designed to allow learners who cannot read, spell or write to pass the subjects and progress to the next class when they are not ready.

Reyneke *et al.* (2010:2) further assert that South Africa is not getting value for its money from its public school system. Although learners have access to education, the majority lack the necessary skills to enable them to cope well in Higher education and the world of work. It was noted with great concern that learners should have high cognitive levels in English to enable them to use it skilfully and that educators should generate effective teaching to address the challenges to learners' proficiency. Educators are also

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expected to set standards to ensure that each learner does not only reach the desired learning outcomes per subject, but also that the learner gets an opportunity to excel. To this end, it is speculated that educators ought to be empowered with a vision of how language teaching, learning and assessment should be implemented at higher levels.

Furthermore, in his debate about the falling standards in education, Kivilu (2004:4) states that higher education institutions and employers in South Africa complain of students passing Grade 12 of low levels of skills. The main complaint revolves around the lack of basic skills in literacy and Mathematics that are considered core to further training and employability. He further argues that the debate about the standard of the matriculation examination in South Africa has reached an alarming level with institutions of higher education, universities and technikons administering their own entrance examinations to protect themselves against what they consider to be poor quality matriculants and also to raise the standards.

In her study on the factors contributing towards the performance of Grade 12 learners in Manoshi and Mokwatedi High School in the Limpopo Province, Rammala (2009:24) attributes poor performance to, amongst others, medium of instruction which is English in this case. She states that, since the new government dispensation, English has become a favoured medium of instruction for the black child. However, most Grade 12 learners struggle to communicate in this foreign language. She, therefore, strongly points to language as one of the strongest factors that disadvantages them in their studies, since English is used to respond to question papers in examinations. She further claims that most learners in the Limpopo Province have some challenges in meeting admission requirements at tertiary level.

Through the research process, Rammala (2009:25) also realised that learners had a serious challenge in responding to research questions in English. During interview sessions, learners could only respond to questions in their mother tongue. The questions had to be translated into their home language each time. It was also remarked that language is a serious matter which affects both mother tongue

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proficiency and English as a medium of instruction. A concern was also raised that learners cannot read in their mother tongue and that it is worse in tests when they are supposed to respond to questions in English. Thus, learners' comprehension and interpretation of tests and examination questions is very low and it results in a high failure rate. Parents also reiterated that learners can hardly read in their mother tongue, let alone in English. She further argued that, since most of the subjects in black schools are offered in English, poor performance should be expected. Thus, educators and parents came up with the suggestion to have learners taught in their mother tongue if they are to improve their performance (Rammala, 2009:25).

Gray (2008:10) argues that *"Although English provides access to job opportunities and education, it is at the same time an obstacle to people with lack of proficiency ....."* He claims that, in many cases learners get to secondary school with a limited proficiency in English, which makes it difficult for them to have meaningful communication in class as expected during the process of learning and teaching as expected. The situation is worsened by the learning resources which are written in English and which demand a high level of proficiency. It is also claimed that about 65.8% of the learners experience serious challenges in understanding Mathematics and Science textbooks. The same findings were also confirmed in the 2006 first phase reading ability survey which revealed that, since the new dispensation, nothing has been achieved to remedy Basic English proficiency amongst black learners (Gray, 2008:7). In the researcher's view, South Africa should not be battling with English proficiency after 20 years of democracy. The country should have already come up with some strategies to remedy the situation.

In her comments on the disappointing 2009 Grade 12 results, the Minister of Education, Mrs. Angie Motshekga, made specific reference to the Mathematics results. She indicated that a positive feature of 2009 was that more learners registered for Mathematics (296 659) than for Mathematical Literacy which was at 284 309. Mathematics results also showed greater differentiation at the upper levels despite an overall decline in the pass rate. She also pointed out that the performance in gateway

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subjects like Mathematics, Physical Science and Accounting remained cause for concern and that it is in the department strategic plans to improve Mathematics performance at Grade 12 and use it as a measuring stick for quality education in South Africa (Mathematics Centre Success Stories, 2010:2). This means that, it is crucial for researchers to expand their investigations on the root cause of learners' underperformance in this gateway subject.

The media statement in which the ANC wished Grade 12 learners success in their examinations, revealed that the Limpopo Provincial Department's objective was to increase the number of matric passes, more especially in Mathematics and Physical Science (Politics Web, 2012:1). Reddy (2006:397), purports that, while we have many policies and programme to improve the state of Mathematics education, the ultimate indicator of success is the performance of learners. Thus, the quality and the quantity of passes in Mathematics are of serious concern in South Africa. Therefore, a school level analysis of performance has to be highly considered apart from analysing the performance per racial group. The president of South Africa, Thabo Mbeki, once raised a concern when he asked, *"How many young black people are matriculating with exemption in Mathematics and Physical Sciences?"* The answer, unfortunately, shows the continuing racial inequalities in the country. He inferred with regret that the situation reflects the declining standard in Mathematics performance which is contrary to the aims of the new dispensation to redress the apartheid imbalances.

In a study conducted at the University of Bristol on the dynamics of language, especially the use of second language as LOLT, it transpired that children learn Mathematics, and other school subjects in English. However incompetence in English was mentioned as a significant factor contributing to low examination performance. This has resulted in some of the researchers arguing that the language of examinations should be in the children's home language if South Africa is to improve the quality of education (Student Performance in National Examination, 2005:1).

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South African Government Information (2012:67) reported a concern on the limited number of learners who pass grade 12 with good symbols in Mathematics qualifying them for university entry. The Department of Basic Education has come up with a turnaround plan called Action Plan 2014 towards the Realization of Schooling 2025 to improve the quality of learning and teaching in Mathematics. The Action Plan also makes provision for the development of language as a vehicle of learning and teaching and focuses on the barriers that learners encounter in the learning process (Parliamentary Monitoring Group, 2011:2).

The National Commission report states that, in view of the importance of Mathematics in society, the gloomy picture of Mathematics raises concern among educators and policy makers as Grade 12 comprises the majority of high school learners (Parliamentary Monitoring Group, 2011:2).

Fischer and Scott (2011:13) also express disappointment with regard to the 2010 Grade 12 results. They indicate the worrying factor on the high number of students who obtained at NSC level very low scores in the subjects that have special significance for university study, for example Mathematics. A detailed analysis of the performance of the 2010 class revealed that the pass rate in key subjects was very poor and the adjusted mean score in Mathematics was 24%. The pass rate in Mathematics clearly depicts that learners' performance has a far reaching impact on one's ability to access higher education.

Thus most researchers agree that a substantial improvement in school quality will take a long time to achieve, especially because of the shortage of qualified and competent Mathematics teachers and the persisting effects of apartheid on education, particularly in Mathematics (Fisher and Scott, 2011:14).

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2.4.3 Theories of Proficiency of Learners in Learning Mathematics in English

This study is underpinned by multi-dimensional theories which apply to the learning and teaching of Mathematics. It encompasses the theory of language proficiency which is constituted by the Basic Interpersonal Communication Skills (BICS) and Cognitive Academic Language proficiency (CALP). The study also incorporated the threshold hypothesis and the input hypothesis.

2.4.3.1 Proficiency of learners in basic interpersonal communication skills and communication academic language proficiency

In an attempt to answer how proficient learners should be in carrying out their studies in a second language, many researchers relate it to BICS and CALP. Cummins (2008:114) makes a distinction between BICS and CALP, in order to draw educators' attention to the challenges that second language learners encounter in the learning process. BICS refers to conversational fluency in a language while CALP refers to learners' ability to understand and communicate in both oral and written modes, concepts and ideas that are relevant to success in the learning of content subjects. Cummins (1994:8) defines basic interpersonal communication skills as a context embedded social language which develops from social activities like play, watching TV, movies, radio and informal conversational exchanges. Because it is embedded in social interaction, social language is thought to be cognitively undemanding.

On the other hand, CALP refers to the abstract, that is higher academic discourse found in formal settings in classrooms. It involves the development of skills such as comparing and contrasting, listing, defending, classifying, predicting, explaining, analyzing, justifying, inferring, deducing, integrating, evaluating, arguing, persuading and defending. Because of lack of environmental clues, academic language is thought to be context reduced but more cognitively demanding than social language. The context is reduced to reading and writing standardised tests, understanding Mathematics concepts, lectures with a few or no illustrations in Mathematics (Cummins, 1994:8).

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Literature Synopsis (2008:1) refers to BICS as part of language we use in daily interaction and which consists of 2000 to 5000 vocabulary, whereas CALP requires much greater vocabulary and more formalised grammar. Conversational skills are said to be acquired between one to two years, whereas CALP is acquired within five to seven years. Language support programmes are often terminated too early in BICS than communication academic language proficiency, which requires extended support. It was also reported that, through a very high quality of enrichment programmes, English second language learners must receive one and half years of content into every one year in school content programmes. Similarly, Slavit and Slavit (2007:3) argue that English language learners should acquire communication academic language proficiency to cope with the academic demands of various subjects. Communication academic language proficiency is applied to acquire knowledge and skills, develop deeper understanding of content and enable learners to effectively participate in content rich discourses. It is also claimed that, social and academic language proficiency complements each other in Mathematics discourses for effective learning.

Lewelling (1991:1) states that the academic achievement of limited English proficiency for learners has been a major national education concern. He suggests that, for learners to progress in class, they should be able to use English as a tool for learning subject matter. It is noted that English language learners often become proficient in communication competence within a short time but they encounter some challenges in understanding and completing school work in cognitively demanding tasks in academic subjects. Moreover, Lewelling (1991:1) also claims that basic proficiency is not adequate as second language learners often do not have enough exposure to the target language, and that they lack understanding of vocabulary and content specific language. It is recommended that the development of academic language should be continuous throughout the schooling period with English language learners.

Dalvit, Murray and Terzoli (2009:2) claim that, learners have challenges in achieving CALP in both their home language and English as a medium of instruction. They claim that the two languages can develop independently at basic interpersonal

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communication skills level, but at CALP level they work interdependently. This means that in de-contextualised and cognitively demanding situations, the level of CALP in the second language depends on the stage of development in one's first language. Thus, the failure to acquire language skills in the home language inhibits the acquisition of academic skills in the second language. This is known as the interdependence hypothesis.

Dalvit, Murray and Terzoli (2009:40) purport that Mathematics involves abstract thinking and mastery of scientific terminology which demands a high language proficiency. Therefore, learners need to be trained in both social interaction skills and academic skills, in both home language and LOLT. However, what worries me is that most learners who use English second language as LOLT lack skills to explain what they know, or to transfer into their first language the new knowledge they have learnt through English. It can, therefore, be concluded that the understanding of Mathematics content through the use of English and mother tongue is minimal.

2.4.3.2 Threshold theory

Cummins (1981:9) came up with the threshold hypothesis which suggests that it is important for bilingual learners to be competent in their first language, as well as their second language to learn mathematics better. He further recommends that the threshold in both home language and second language as a media of instruction should be developed. The first threshold denotes the level of linguistic competence that learners should reach, in order to avoid the negative consequences of bilingualism, while the second represents the level of linguistic competence required to access the possible cognitive advantages of bilingualism (Brault, 2001:67).

The threshold theory identifies the subtractive environment and additive environment. The subtractive environment is where the second language replaces learners' home language. The additive environment, however, refers to the situation where the second language is added to learners' home language. Learners are considered to be balanced bilinguals when they are competent in both their home language and second

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language. It is reported that balanced bilinguals who learn their languages in the additive learning environment have cognitive advantages over monolinguals or those who have learned Mathematics solely in their first language. This was proven in a study that was conducted to examine the ability of bilingual Italian and Jamaican learners. The findings revealed that balanced bilinguals reason deductively in Mathematics. It was also realised that learners' first language competence was an important factor in the ability of ELLs to reason in Mathematics (Nillas, 2002:96).

Brault (2001:68) divides the threshold theory to three levels of linguistic competence of learners in both home language and English as LOLT as follows:

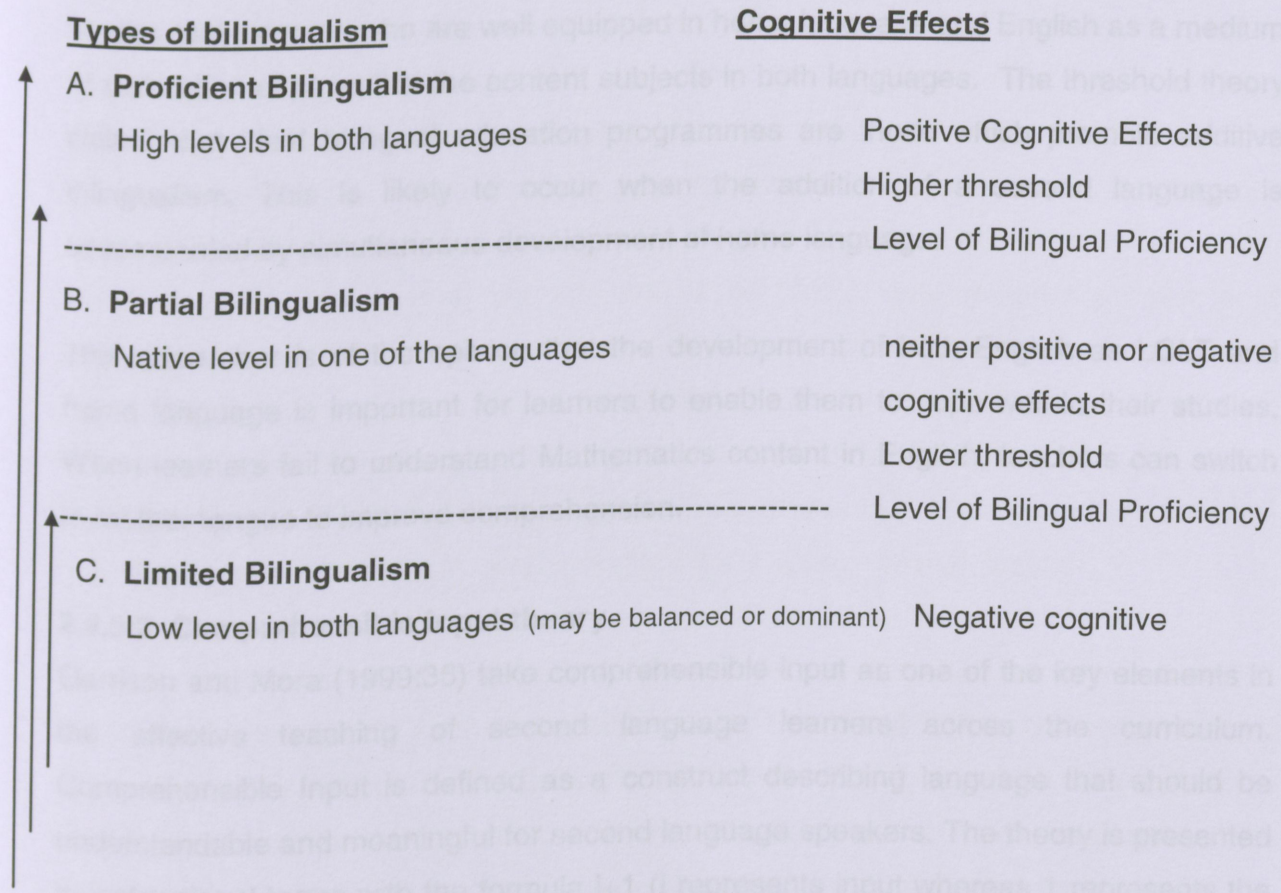


Figure 2.1: The Threshold Theory on the Levels of Language Competence (Source: Adapted from **Proficiency Level of Bilingual Second Language Learners** (p68) by Brault, 2001).

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The bottom arrow represents learners whose level of language skills in both home language and English is insufficiently developed for their age group. The theory postulates that in such cases, the cognitive effects of bilingualism may be negative as linguistic weaknesses may prevent them from adequately coping in lessons regardless of the language used. The middle arrow represents learners who have developed age appropriate language competence in one language. At this level, there is little cognitive difference compared with the monolingual learner. As such the benefits are neutral as the expected performance of learners is on average. Thus such learners cannot excel in their studies due to language barriers. The top arrow represents learners who are balanced bilinguals with appropriate competence in both home language and second language. In this case, learners can cope with the content in either language. This implies that learners who are well equipped in home language and English as a medium of instruction cope well in the content subjects in both languages. The threshold theory claims that ideal bilingual education programmes are those which promote additive bilingualism. This is likely to occur when the addition of a second language is accompanied by simultaneous development of home language.

The researcher is of the opinion that the development of both English as LOLT and home language is important for learners to enable them to cope well in their studies. When learners fail to understand Mathematics content in English, teachers can switch to mother tongue to improve comprehension.

2.4.3.3 Comprehensible input theory

Garrison and Mora (1999:36) take comprehensible input as one of the key elements in the effective teaching of second language learners across the curriculum. Comprehensible Input is defined as a construct describing language that should be understandable and meaningful for second language speakers. The theory is presented in instructional terms with the formula i+1 (i represents input whereas 1 represents the level of comprehensible input). On one hand the symbol (i) further indicates that learners should be in a situation where they receive comprehensible input if they are to learn effectively. On the other hand, 1 shows the level of comprehensible input that

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should be one level more complex than the second language proficiency of a learner. This kind of input allows for language to be understood, while also challenging learners to increase their second language proficiency.

The Virginia Department of Education Division of Instruction (2004:2) outlines comprehensible input as one of the key elements of an effective language learning environment. It is claimed that comprehensible input is a learning strategy that assists learners in accessing content in Mathematics. Acquisition of content is said to be possible when learners receive comprehensible input. In other words, the message should be meaningful and understandable, and should be a bit beyond learners' comprehension level. Educators are, therefore, supposed to make their language more comprehensible by modifying their speech and adjusting teaching materials.

Algerienne (2000:1) clarifies the application of comprehensible input in Mathematics classroom when she claims that the comprehensible input is a construct of second language development meant to support learners with and without learning difficulties. Comprehensible means that learners should be able to understand the essence of educators' presentation in class. She also claims that learners understand subject content when they receive comprehensible input, which is just a bit more difficult than they can easily understand. Thus, learners should understand most, but not all the words the educator uses. This strategy exposes learners to a situation where they are challenged to understand new words or complex language in each lesson.

Garrison and Mora (1999:36-37) demonstrate how teaching can be implemented in class in terms of providing comprehensible input. They assert that comprehensible input is provided in the school context through well planned strategies, which involve the use of concrete contextual references and the use of learners' home language. The principle of academic instruction called Sheltered Instruction is recommended for English language learners. Effective instruction is based on advancing from one level of understanding to the next level of complexity of Mathematics content.

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In addition, Krashen (2008:2) purports that, in order to acquire language, learners should receive comprehensible input. To him, comprehensible input is a combination of structures that learners already know plus other new structures, so that learners can still comprehend content. He holds that when learners are exposed to a new language in this way, it can be acquired with ease.

Krashen (2008:3) argues that comprehensible input is not sufficient in the acquisition of language; it also involves output as a vital phase in language acquisition. Output requires linguistic production as a significant aspect of learner success in the delivery of curriculum. Output also enables educators to judge learners' progress in their learning and adapt learning materials and activities appropriately. It compels learners to reorganise and elaborate upon their knowledge of second language. The input and output interact in the negotiation of meaning and extension of learners' linguistic knowledge.

2.4.3.4 Common strengths of theories of learning Mathematics

The three theories, BICS and CALP, Threshold Hypotheses, and Comprehensible Input Hypothesis are complementary to one another and have common elements. All the theories advocate consideration of linguistic aspects in the teaching and learning of Mathematics. They promote the development of English and home language in order for second language learners to be successful in their studies in Mathematics. The theories encupsulates that second language learners should pay attention to the mastery of the target language and home language while they are learning Mathematics content.

Furthermore, the three theories are built on the implied interdependence between the first and second language proficiency. The interdependence principle assumes that the development of the second language is dependent on the proficiency of learners in their home language. Thus, the common underlying proficiency makes possible the transfer of literary related skills across languages. For instance, if learners understand concepts in their first language, they are highly likely to understand it in the second language with

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ease. However, learners who do not understand the meaning of concepts in their home language find it difficult to follow their meanings in the second language.

The three theories would complement one another on how Mathematics content should be learnt. Language proficiency requires learners to acquire BICS and CALP in both home language and English as a language of instruction if they are to succeed in learning Mathematics. The threshold hypothesis denotes the level of linguistic competence that learners should acquire for effective additive bilingualism that enhances progress in the learning of Mathematics. Comprehensible input, as a construct of second language learners, advocates for access to Mathematics content in an effective way.

These three theories are crucial in this study as they outline language competences that learners should acquire in order to cope with the study of Mathematics in English as second language. The theories serve as guidelines that should be considered by education planners for effective curriculum delivery. Hence, the guidelines should be accommodated in the subject teacher guidelines.

2.5 SUCCESS OF MATHEMATICS (AS A SUBJECT) IN THE HIGH SCHOOLS

The success of the use of English as second language and medium of instruction in the learning and teaching of Mathematics has been widely investigated by many researchers globally.

Riodain and Keefe (2012:2) assert that, in several sub-Saharan states, the use of language that is not the home language of learners coerces educators to follow educator centered methods of instruction. The teaching approach involves chorus expressions involves learners responding to educators in unison. It also involves repetition, memorization and the recalling of content. Such practices are widely identified in literature as promoting low academic achievement in difficult subjects like Mathematics. It also transpired that, if Mathematics instruction is relegated to rote

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learning, we rob learners of the opportunity to acquire deeper understanding of the logic, beauty and the vast applicability of Mathematics in all aspects of life. The only way to teach learners to master the basics of Mathematics and have skills in problem-solving is to teach using concept-rich instruction.

Menoe (2005:10) claims that Mathematics in secondary schools is mostly educator centered. There is an emphasis on lecturing as a teaching method, question and answer exchange, administration of written exercises, note-taking and, eventually, the administration of tests and examinations. The emphasis is always on memorisation and recalling than on understanding the process of problem-solving and creativity. In this situation, learners' involvement is minimised. Educators are more likely to talk while learners listen, copy notes, and answer when they are called upon. Such learners prefer to work silently on the class assignments and they rarely ask questions unless they are allowed to speak in their home language. In this situation, educators concentrate much on factual information and ignore linguistic aspects of the matter. Incorrect answers are likely to be ignored to avoid a discussion. This implies that, in most second language classrooms, communication between Mathematics educators and learners tends to be limited. The reason is that everyone is sensitive about the foreign language, hence they avoid making mistakes.

Menoe (2005:10) further attribute lack of communication in classrooms to educators' lack of confidence and mastery of subject matter and basic teaching skills. The other reason behind the practice is that examinations have a dominant influence on classroom instruction. Teaching is mostly based on preparing learners for examination papers. Hence, teaching methods are ineffective and dysfunctional. It is suggested that a learner-centered approach should be implemented for the effective teaching of Mathematics. It was also noted that most countries also experience problems associated with the teaching approach, which leads to the poor performance of learners in Mathematics. Other problems include language problems, automatic promotion and poor Mathematics background provided in the entire school system. Most educators, in

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both developing and developed countries, are still grappling with how to successfully implement learner-centered teaching practices.

The use of English as LOLT leads to code switching and code mixing of home language and mother tongue in the Mathematics lessons. Code mixing and switching are meant to camouflage the linguistic shortcomings of educators and learners during the course of lessons. This is due to the fact that learners are only exposed to English in the formal situation in classrooms. In confirmation of the state of affairs, the review of the curriculum 2005 debate presented in PRAESA No. 6 (2000:30) reports that, at best educators are often heard code switching and mixing. It is, therefore, claimed that the language model provided for South African learners is a code mixed model. This is said to be the closest learners can get to the English language. Code switching and mixing are associated with inflexibility of the brain to separate mother tongue and English as a second language. Hence, the brain thinks semi-native and semi-English way, and hinders the mastery of LOLT.

In their research conducted in Turkey, Kocakulah, Ustunluoglu and Kocakulah (2005:2) purport that the effect of teaching academic subjects in a foreign language cover problems related to psychology, linguistics and examination. The effect of the foreign language is explained in terms of language proficiency in relation to Basic Interpersonal Communication Skills and Communication Academic Language Proficiency. It is claimed that most learners acquire Basic Interpersonal Communication Skills (basic interpersonal skills) and lack Communication Academic Language Proficiency (cognitive academic language proficiency). It is argued that, learners who have not developed their Communication academic Language Proficiency are at a disadvantage in studying academic subjects like Science and Mathematics in particular. These subjects require an in-depth understanding of concepts acquired through reading textbooks, participating in discussions, debates, providing points and responding to questions in tests.

In the researcher's view, the argument is valid because some learners communicate well in English and also pass it as a subject. However, the same learners struggle

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considerably with Science subjects. This means that such learners lack cognitive academic language proficiency which is a pre-requisite for understanding subject matter.

When the Curriculum and Assessment Policy Statement (2008:8) expect the curriculum to provide strong support for those learners who use English as LOLT it is striking that the situation in South Africa is bad. The policy envisages that, by the end of the senior phase (Grade 9) learners should be reasonably proficient in English as LOLT, especially with regard to both interpersonal and cognitive academic skills. However, the reality is that many learners still cannot communicate well in their first additional language at this stage. The challenge is to provide support for ELLs while at the same time providing a curriculum that enables learners to meet the standards required in further grades. Even in further education and training, learners are still not competent enough to carry out their studies in English. The challenges include lack of linguistic support and provision of a curriculum that enables learners to meet the standards required in Grade 12 and Higher Education.

Kocakulah *et al*, (2005:3), moreover, claim that learners who struggle to learn Science subjects in a second language lose at least 20% of their capacity to reason and understand content in their learning process. They also assert that learning academic courses through English poses problems for learners whose mother tongue is not English. The reason is that learners get frustrated by failure to see meaning in the texts and develop a tendency towards rote learning. As such, not much is stored in their memory since what is learnt by rote learning is easily forgotten. Linguistic effects are a result of one's lack of knowledge of syntax, grammar and meaning of words used in different contexts. Poor knowledge of these rules put second language learners at a disadvantage, as compared to first language learners who have been exposed to inherent and informal methods of learning their language at an early stage.

Yushau and Bokhari (2001:3) also argue that learners who are weak in the language of instruction are more likely to have ill-comprehension, as well as poor participation in

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classroom discourses. Hence, these learners are likely not to meet the learning objectives due to a lack of communication skills. The situation puts educators in a dilemma on how to address learners' difficulties and detect whether the problems are related to Mathematics or language.

The Department of Science and Technology (2008:16) interview report revealed that learners who had chosen Mathematical studies had personal stories of hardships and persistence with their studies. The learners showed that they endured hardships for they had deep love for Mathematics which was coupled with a dose of luck in their success. The panel realised that there were many talented learners who were lost and never had an opportunity to develop a love for Mathematics. The panel recommended that the Mathematics foundation should be strengthened, and the best learners should be identified and encouraged to take Mathematics programmes.

Due to the challenges that second language learners encounter in their studies, it is noted with regret, that at every stage of education, more learners in Africa drop out of Mathematics studies. Hence, the situation prevents the education system from producing their own future labour force (John Templeton Foundation, 2009:7, Dalvit, Murray & Terzoli, 2009:47). The drop-out rate of learners, both at primary and secondary level, is estimated at 70% in townships and rural areas (Deyi, Ngcobo & Thole, 2007:2). They further claim that few learners who manage to sit for Grade 12 examinations do not perform well. Their results are not pleasing. A research undertaken by the South African Institute of Race Relations revealed that only 8% (84 741) of the (1 057 935) learners who started Grade 10 in 2004 passed Grade 12 exams in 2006 and obtained entrance to University studies. The Department of Education purports that learners' limited proficiency in English is the main contributory factor in the performance levels. It was also stated that learners could have achieved better if the examination had been administered in the language they know well.

Dalvit, Murray and Terzoli (2009:47) conclude that the current English, mainly the model adopted in rural and township schools, neither produces education excellence nor

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English proficiency. Instead, it hampers the process of social transformation in the education system.

Boals (2006:1) raised a concern about the never ending debate about whether teaching should be conducted bilingually or in English with ELLs. The concern is intensified by the anecdotal evidence that while too much time is wasted on bilingual debates, black learners are dropping out of the school system two or three times the rate of white English speaking learners. The main issue to be promptly addressed is to find out the best approach to learn English while learning Mathematics, Physical Science and all the other subjects in the school curriculum. In this context, English proficiency is a pre-requisite meant to close the academic gap in the education system. To this end, whatever strategies are preferred, they should ensure academic and linguistic success.

In the researcher's view, when learners are overwhelmed by linguistic challenges in the learning of Mathematics they resort to dropping out of the school system. Some of them get frustrated and end up committing crime. Most of dropouts depend on the child grant to earn their living instead of joining the labour force.

Due to the use of English as a medium of instruction, South African learners do not perform well in Mathematics. However, there is variance of learners' performance from different socio-economic conditions, racial groups, provinces etc. The Human Science Research Council estimates that 30% of the schools that perform well in Mathematics while 70% underperform. Another feature of the South African education system is that the national average achievement scores for different grade levels across the schooling system is similar and stable around 30% to 40%. It is surprising that the performance of underperforming schools continues to be low even with many intervention strategies implemented in the high schools (HSRC Review, 2011:1).

In support of the argument, the researcher has observed that there are schools which are known to be performing while some are persistently underperforming. Most of the schools go an extra-mile to uplift their performance in Mathematics. Schools generally

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conduct extra-classes after school, during weekends and vacations. The communities, churches and parents also play an important role in supporting learners in their studies by supervising studies and offering extra-tuition. However, the results are always below the expected standard.

2.6 MODELS OF TEACHING MATHEMATICS THROUGH ENGLISH AS LOLT AND BEST PRACTISE IN THE TEACHING OF MATHEMATICS IN ENGLISH

This section discusses the recommended models of teaching Mathematics in English as a language of learning and teaching. The recommended models comprise teaching learners within the zone of proximal development and the application of the second language approach to Mathematics skills. The section also outlines the best practices in the teaching of Mathematics using a second language.

2.6.1 Zone of Proximal Development (ZPD) in the Learning and Teaching of Mathematics

Vygotsky came up with the concept of the zone of proximal development in relation to teaching and learning of Mathematics and other learning areas. The approach has gained popularity with researchers. Siyepu (2013:3) and Chaiklin (2003:2) define the zone of proximal development as follows:

> *A distance between the actual development levels as determined by independent problem solving and the level of potential development through problem solving under adult guidance, or in collaboration with more capable peers.*

Vygotsky (1978:32) defines the ZPD as functions that have not yet matured but are in the process of maturation. The functions that are still in the embryonic state are termed the "buds" or "flowers" of development. The actual development level characterises mental development retrospectively while the ZPD characterises mental development prospectively.

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It is further claimed that educators can use the ZPD to bridge the gap between what learners can do without help and what they can do with assistance. Siyepu (2013:5) asserts that learners' thinking and problem-solving ability fall in three categories, namely those that can be performed independently; those that can be performed with assistance; and those that cannot be performed even with assistance. He also purports that learners' understanding of Mathematics is facilitated by meaningful activities, classroom discussions and exercises that are done inside and outside the classroom in terms of the ZPD. He explains the learning process of the ZPD in the form of a model as follows:

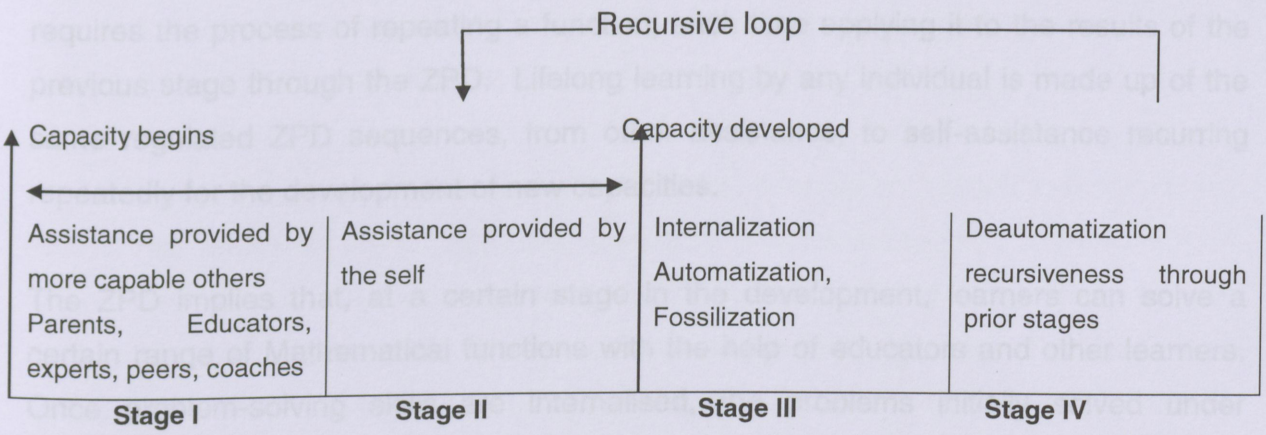


Figure 2.2: Zone of Proximal Development (ZPD) in the Learning and Teaching of Mathematics

(Source: Adapted from **The zone of proximal development in the learning of Mathematics in South Africa** (p5) by Siyepu, 2013

Stage 1: Stage one demonstrates how learners develop when they use a language that is appropriate to their study and the basics of the topic under study by relying on others such as educators, peers, parents, expert coaches etc. to perform a task.

Stage II: In the second stage, learners use prior knowledge to carry out tasks without any guidance. The ZPD occurs between the first and the second stages. Learners

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practice alone, and this means that they perform certain activities without assistance. However, at this stage, they are not at a stage of perfect proficiency yet and they sometimes need support.

Stage III: In the third stage, performance is developed to an automatised state in which they perform tasks without thinking because knowledge is fixed and it cannot be forgotten. It is the stage of independence in which they no longer need help from adults or to practice more exercises to reinforce the already existing knowledge.

Stage IV: In the fourth stage, learners are at the deautomatisation of performance that requires the process of repeating a function, each time applying it to the results of the previous stage through the ZPD. Lifelong learning by any individual is made up of the same regulated ZPD sequences, from other assistance, to self-assistance recurring repeatedly for the development of new capacities.

The ZPD implies that, at a certain stage in the development, learners can solve a certain range of Mathematical functions with the help of educators and other learners. Once problem-solving skills are internalised, the problems initially solved under guidance can be tackled independently without support (Siyepu, 2013:6). The researcher concurs that the development of Mathematical functions occurs in stages and that learners should be able to work out the developed functions on their own without assistance. Learners who fail to develop their potential to independence stage are not taught within their proximal development. The situation poses a challenge for educators to improve the teaching strategies to achieve effective teaching in Mathematics.

Christmas, Kudzai and Josiah (2013:371) also assets that the ZPD is central to instructional enhancement in Mathematics. They opine that Mathematical knowledge develops through stages. The first stage refers to what a learner can do alone at a particular point in time whereas the second stage refers to the potential development

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which a learner can achieve with support. The ZPD concept is presented in the form of a model as follows:

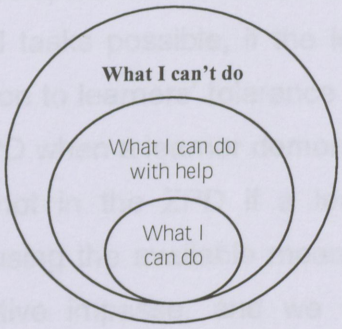


Figure 2.3: Zone of Proximal Development of Second Language Learners Adapted from Chistmas, Kudzai & Josiah, 2013:371

The inner cycle represents the zone of achieved development, which indicates that a learner has mastered the Mathematical concepts and can independently perform them without assistance. The middle circle is the ZPD where learning can proceed with the assistance of an expert. This is referred as an active learning zone. The outer circle denotes the area in which even with the profound assistance of an expert, the learner will not learn. Hence, it is referred to as a confused zone.

Chaiklin (2003:3) advocates for learning within the ZPD which states that the property of a learner enables the best and the easiest learning. The property of a learner involves the learners' potential and/or readiness to learn which are requisites for effective learning in any learning area. This means that, if the ZPD is identified, it will greatly accelerate and facilitate learning process. Learners' potential for new learning is strongest within the ZPD. One can, therefore, infer that teaching in the ZPD should result in the effortless learning for ELLs.

Similarly, Christmas, Kudzai and Josiah (2013:372) claim that the ZPD denote functions that have not yet matured, but are in the process of maturation. The ZPD is said to be critical for Mathematics learning and instruction because it determines the

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level of work to be taught which is desirable to the learner. It is argued that teaching within learners' developmental levels is ineffective and that effective learning is in advance of learners' developmental level. The effectiveness of ZPD is defined by the difficulty of Mathematical tasks possible, if the learners are given necessary support. This zone differs in relation to learners' tolerance for boredom and confusion. Learning is claimed to be in the ZPD when a learner demonstrates efficient and effective learning. However, a learner is not in the ZPD if a learner is bored and unable to solve Mathematical problems using the available means of assistance. Such learners have reached a non-constructive impasse, and we can thus infer that they are in the confused zone.

Shabani, Khatib and Ebadi (2010:238) claim that the main idea is to keep learners in their ZPDs as often as possible by giving them interesting and culturally meaningful learning tasks that are slightly more difficult so that they learn further. The process is repeated at a higher level extending the ZPD. However, the tasks assigned to the learners sometimes fall outside the ZPD, either covers what learners can already do by themselves, or tasks that the learners would not be able to do even with help. The focus of teaching is on tasks inside the ZPD, which the learner cannot do by himself but has the potential to accomplish with the guidance of others. As learners accomplish their ZPD, or the gap between what they can do on their own and what they can only accomplish with assistance, shrinks.

Similarly, Vygotsky (1978:32) claims that an empirically established fact is that learning should be matched with the learners' developmental level which denotes functions that have already matured. This is the end product of development. The ZPD is defined as the functions that have not yet matured, which are in the embryonic stage of development. These functions are termed "buds" or "flowers" of development rather than fruits of development. To him, the actual development level characterises mental development prospectively. If there are two learners of the same age in the same grade, one attending school regularly and the other one missing classes, at the end of the year, those learners will still be in the same age group, but they will display different

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developmental dynamics. The one who does not miss classes would have acquired more developed functions. The example clearly shows that, if learners are missing some content in the learning areas, they end up falling behind on the function they are capable of performing independently. This results in learners having some difficulties in understanding Mathematics content in the grades that follow.

The high failure rate in Mathematics, in South Africa in general and in the Vhembe District in particular, implies that Grade 12 learners have not yet acquired much in the zone of achieved development. Thus, they have not acquired enough functions that can allow them to engage in further learning. Once they reach a non-constructive impasse that impedes further learning, one can deduce that their potential is out of the ZPD. Therefore they experience boredom and frustration in Mathematics classes leading to failure because they lack basic knowledge which they were supposed to have accumulated in lower classes.

The South African Minister of Basic Education announced in a media conference held on 04 January 2012 in Pretoria that the pass rate for Mathematics in the Matriculation examination was 46,3% in 2011, and that there was a decline from 47% in 2010 (Siyepu, 2013:2). This indicates that Mathematics is still a problem in South Africa. In spite of the poor pass rate, it is further claimed that several lecturers who taught first year Mathematics in 2009 reported under-preparedness of students. Such students were said to be at risk, because they were experiencing low academic achievements due to low achievement in the schooling system and they also have low confidence. Therefore, the identification of students at risk and the development of programmes to prevent their failure, are necessary components of educational reform in universities.

Christmas, Kudzai & Josiah (2013:372) present the teaching within learners' ZPD by promoting consideration of LOLT which they regard as mediators in the learning of Mathematics. They claim that apart from the support learners receive from other people who enhance their learning, language as a learning tool plays an important role. LOLT

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is taken as a vehicle of interaction that promotes learners' understanding of content from one level to the next (Christmas, Kudzai & Josiah, 2013:372).

Shabani, Khatib and Ebadi (2010:238) also describe the ZPD as the current or actual level of development of a learner and the next level of attainment through the use of mediating semiotic and environmental tools and capable adults or peer facilitation. They advance the idea that learners learn best when working with others during joint collaboration with more skilled persons. In that situation, learners learn and internalise new concepts and skills.

Czarnocha and Prabhu (1998:1) support the role of language in learning Mathematics and refer to it as an area that has not been fully explored in research. They focus on the role of educators as educators of language needed to learn Mathematics concepts and skills. The relationship between thought and language are seen to be in a reciprocal relationship of development. In order to think, we need to communicate and, in order to communicate, we have to think. Mathematical thought might shape natural language. One through which this process can take place is across the ZPD. The ZPD arises in Vygotsky's thought through the distinction between spontaneous and scientific concepts. It represents the depth to which a learner can develop, with expert help, his spontaneous concepts concerning a particular problem – as opposed to his/her ability to do it alone.

Similarly, Siyepu (2013:8) places communication at the centre of his theory of language and thought in which he argues that thought is completed in words. This implies that, in designing learning activities, educators should pay attention to arranging interactions where the educator and learners can pause to comment on their problem solving efforts in oral or written reflections. Thus, communication is important in developing Mathematical understanding within the cultural perspectives. Learners exchange ideas and listen actively to one another's views. This creates mutual understanding based on culturally established Mathematical practices. Language is, therefore, a cultural tool and a human instrument of communication.

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Siyepu (2013:7) further claims that ZPD is a learning process that functions on social and psychological planes. Psychological tools are inclusive of language, counting, writing, diagrams, maps, etc, while the social plane involves interaction of people during the course of lessons. In the learning situation, educators use learners' prior knowledge and experiences of developed functions in the previous levels. For instance, in classroom discussions, learners explain and justify their understanding and interpretations of the target topic to other members of the class.

The socio-cultural theory emphasises that the most advantageous learning environment is the one where dynamic interaction between educators, learners and tasks provides an opportunity for learners to create their own understanding. Learners are expected to be makers of meaning, while educators guide them to gain meaningful understanding of the content through active communication (Siyepu, 2013:9).

The researcher speculates that learners who are not proficient in English, struggle in understanding Mathematics because they are not taught in their zone of proximal development. Hence, they have a lot of tasks they cannot perform independently. They continue to depend on the support of teachers and peers throughout their education. Most of them fail Mathematics even when they are given extra tuition during weekends. Some learners progress through the grades without passing Mathematics. Most of them give up on Mathematics or perform badly in it.

2.6.2 Second Language Approach to Teaching Mathematics Skills (SLAMS)

Cuevas (1984:140) presents the second language approach to teaching Mathematics skills, namely diagnostic/prescriptive system to teaching of Mathematics. The method incorporates strategies for dealing with linguistic skills of learners with a limited proficiency in English as LOLT. The approach also considers the need to master Mathematical concepts and skills. The model is presented as follows:

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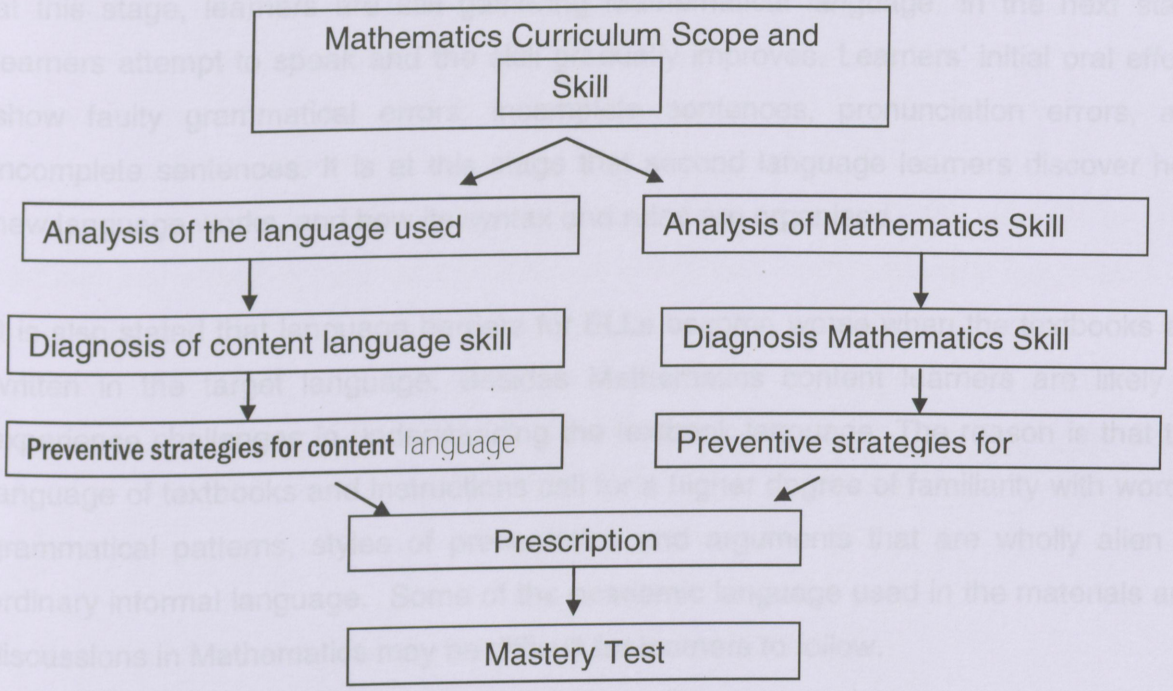


Figure 2.4: Second Language Approach to Teaching Mathematics skills
(Source: Adapted from **Mathematics learning in English as a second language** (p140) by Cuevas, 1984).

The model has two strands, one focusing on Mathematics content and the other on related language skills. The activities for each strand are based on instructional objectives from the curriculum used by the educator. The content strand encompasses strategies for analysing and diagnosing Mathematics skills followed by the preventive or prescriptive activities. The language strand follows a parallel path. First, the language skills required by instructional objectives are identified. Second, the educator diagnoses the extent to which the learners pose the skills. Third, the educator designs and implements appropriate preventive or prescriptive language teaching activities (Cuevas 1984:140).

Cuevas (1984:135) claims that Mathematics educators who are teaching ELLs need to be cognisant of the complex process of teaching. It is stated that the process starts with a period of listening to the sounds and words of the target language. This implies that

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at this stage, learners are still gathering Mathematical language. In the next stage learners attempt to speak and the skill gradually improves. Learners' initial oral efforts show faulty grammatical errors, incomplete sentences, pronunciation errors, and incomplete sentences. It is at this stage that second language learners discover how new language works, and how its syntax and rules are organised.

It is also stated that language barriers for ELLs become worse when the textbooks are written in the target language. Besides Mathematics content learners are likely to experience challenges in understanding the textbook language. The reason is that the language of textbooks and instructions call for a higher degree of familiarity with words, grammatical patterns, styles of presentation and arguments that are wholly alien to ordinary informal language. Some of the academic language used in the materials and discussions in Mathematics may be difficult for learners to follow.

The researcher supports the idea that most ELLs have difficulties in understanding Mathematics textbooks. Through experience, the researcher realised that most learners in the Limpopo Province do not carry textbooks to school. They prefer listening to educators' presentation in class and writing notes. This implies that Mathematics educators have to convince learners to understand the importance of bringing along textbooks to school. There is also a need to teach learners how to use them.

Cuevas (1984:135) claims that the rate at which learners develop language skills that enable to use it as LOLT is influenced by social and cognitive abilities and the desire to learn. Some learners master LOLT skills in a period between one and three years of effective teaching, while some take longer than that. However, those ELLs who lack social interchange skills face frustration and high failure rate at school. Cuevas (1984:135) further claims that the rate of exposure and the support learners have in the learning process, influence the rate of learning. Furthermore, the various aspects of learners' native language and culture can either facilitate or inhibit learning. This implies that educators have a challenge of maximum exposure of learners to English for effective learning of Mathematics.

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It is asserted that learners require considerable proficiency in both the mother tongue and English to cope with the range of linguistic activities required for effective learning of Mathematics. It is suggested that the curriculum should include the development of language skills required for academic success. The notional/functional syllabus which advocates for the development of cognitive and language skills for learners to learn Mathematics effectively is recommended. Furthermore, vocabulary and language skills necessary to achieve the learning objectives should be identified and incorporated into teaching activities. It is recommended that when learners enter ELLs programmes, diagnostic tests should be administered on their language proficiency in the target language. It is, therefore, suggested that Mathematics curriculum should be revised to incorporate language skills required by ELLs.

2.6.3 Content and Language Integrated Learning (CLIL)

There are some researchers who advocate for Mathematics to be taught simultaneously with the development of language of teaching and learning. For example, Van den Craen (2002:1) came up with the content and language integrated learning (CLIL) model which is content-based language teaching approach suitable for second language learners. Van den Craen (2002:7) claims that learning a subject in the second or foreign language exits highly cognitive load entailed by both subject matter and language of learning. However, he comes up with the intervention strategies that can be helpful in closing the gap. He recommends scaffolding as a supportive mechanism that can be employed in the teaching process. Scaffolding refers to the informal, unplanned intervention of educators and other learners to correct or expand statements uttered by ELLs during the learning and teaching process. For instance, when a learner misses a word in the target language and asks for assistance from the educator or other fellow learners to be reminded. The scaffolding happens spontaneously because it is part of an on-going conversation where meaning is put across. The added value of scaffolding is that interaction is perfectly natural, accepted and appreciated by both the educator and learners. What is important is that the meaning and the flow of the lesson is not disturbed and, as a result, the cognitive load is lessened.

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Furthermore, CLIL takes the philosophy of correction into account in the learning process of second language learners. CLIL is practiced with a bit of tolerance that should be observed especially by taking into account the slow reaction of second language learners in a communicative environment. Thus, ELLs take time to react and respond because they need time to process information before they respond both orally and in writing. Their pace picks up as they develop fluency in the target language. It is claimed that their learning improves rapidly in a CLIL environment because the low cognitive burden together with the way knowledge is acquired strengthen one another in class. In this way, language is seen as a correlate of subject matter learning much in the same way as learning how to play a piano. The environment is regarded as a correlate of wanting to listen to a beautiful melody. This implies that learning becomes fun and arouses learning interest. In such a learning environment, learners open up and they do not feel shy as they get used to being corrected immediately when they make mistakes. Feedback on learners' understanding is given regularly. This eventually helps them to follow the entire lesson.

Van den Craen (2007:11) interprets the linguistic burden in terms of the phases that ELLs have to go through in the content learning process. In the beginners' phase, learners know certain words, but they are unable to converse. As such, they have a heavy cognitive load because they are still slow in understanding, and are easily disturbed by competing demands such as thinking and learning. In the second intermediate phase, the cognitive load is lessened, and learners pick up the learning pace, have less error. However, numerous mistakes are still made. In the third advanced phase, ELLs have a low cognitive load, and they have acquired native like fluency in the target language. As learners develop through phases, from declarative to procedural knowledge, they move from factual knowledge to automatized process. They slowly internalise rules which need less consciousness and cognitive effort to remember. At the same time their linguistic performance improves from error prone to native speaker like performance and command. The phases help educators to apply appropriate support for learners.

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Similarly, Gibbons (2002:36) came up with the issue of learning in a second language which is referred as a blue print to teach learners who are not English speakers. According to him, the role of the educator is to create a classroom context that would foster academic, linguistic and personal growth. Learners are expected to take an active role in the learning process. Hence, it is recommended that effective learning takes place through classroom interaction.

Educators are expected to provide scaffolding support. Scaffolding is regarded as a tool for educators to support learners to learn skills and also how to apply them to become independent learners. Gibbons advocates for a common teaching practice that advocates for the integration of the actual teaching of English alongside the content areas demanded by the national curriculum. She further states that teaching the content and the rules of a genre should be treated explicitly. In this context she claims that educators should strive to address learners' needs on the content they are struggling with. She recommends that educators should understand and relieve learners from the linguistic pressure and help them out in order to achieve learning goals. This requires educators to plan their lessons effectively taking into consideration the language demands of content topics.

The researcher advocates that English language learners should be supported by teachers to develop the linguistic competence needed for effective Mathematics learning. It should not be taken for granted that language skills will develop in the course of learning and teaching. Hence deliberate intervention is recommended if educators want to promote Mathematics learning.

The researcher agrees that learners can develop their full potential in Mathematics when they are getting linguistic support from both educators and fellow learners. Learners, themselves, should play an active role in their studies.

Crandall (1993:1) also came up with content centred language instruction. Although her study was focused on the United States, she claims that similar interest is evident in

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many countries in the world where English serves as a medium of instruction in the education system. She recommends the programmes that should be developed to meet the needs of minority learners. These involve the integration of language in the instruction of Mathematics, Science and other academic subjects.

It is claimed that content-centred instruction is effective when language input is at or just above the proficiency of the learner and when there is sufficient opportunity for learners to engage in meaningful interaction in an anxiety-free environment. This suggests that the focus of the second language classroom should be on something meaningful, such as academic content and modification of the target language. This would make content accessible to learners. It is speculated that this can be achieved when basic interpersonal communication skills and cognitive academic skills are developed.

2.6.4 The Best Practices of Teaching and Learning Mathematics

This section provides research-based best teaching and learning practice evidence that should be employed in Mathematics classroom to reduce the barriers that are likely to be experienced by second language learners. Researchers came up with various practices which are supportive of the teaching and learning of Mathematics.

- **Simplify and elaborate language**

Kersaint (2007:1) recommends that educators should simplify and elaborate language involved in the topic to provide access and opportunities for pupils to learn effectively. Educators have to be cognisant of both the English and Mathematics words that will be involved in the lesson. It involves simplifying complex language notions, vocabulary and using familiar language to explain concepts.

- **Express mathematical information in multiple ways**

It is recommended that educators should express Mathematical information in multiple ways. The expression should involve a variety of vocabulary so that learners can make connections of synonyms that are used in both Mathematics and English. For instance,

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English language learners may be familiar with the phrase "take away" but not relating it to the synonym "subtract", "minus" or "difference". The use of such synonyms in the same lesson can help learners to establish the connection between the phrases (Kersaint, 2007:2).

- **Directly teach mathematics vocabulary**

Bill *et al.* (2005:15) claim that it is not enough to just teach conversational English; Mathematics vocabulary should be taught. The previously learned vocabulary should be reviewed when it is used in each lesson. Learners are expected to restate definitions or meanings of vocabulary in their own words. Teaching vocabulary also involves building glossaries using meanings of words in everyday language or applications. Learners improve understanding in Mathematics when they are exposed to vocabulary games. Some of the common games that can be useful include jeopardy charades, Bingo, and concentration. Other activities include pantomiming, acting out new words or having learners invent their own game with a set of rules to be followed.

It is, thus, of utmost importance to introduce Mathematics vocabulary to ELLs so that they can get used to mathematical language. When they have accumulated enough vocabulary, they will be able to engage in Mathematical discussions. The glossary keeps track of the content learnt, whereas games make learning fun and improve the listening span.

- **Use drawings and illustrations to support communication**

Moreover, the use of drawings and illustrations are recommended to support communication in second language classrooms. Drawings and illustrations help learners to visualise and make sense of words used in the lessons and also make it easy for them to follow content presentation. Such presentations are intended to simplify subject matter (Kersaint, 2007:2).

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- **Eliminate linguistic complexities**

It is also claimed that Mathematics educators should eliminate linguistic complexities inherent in English language. The English language includes some complicated features such as the use of articles, pronouns to name but a few. Communication, which is piled with such language features, might be challenging to English language learners. Therefore, such features should be eliminated or clarified in case they are used during the course of lessons (Kersaint, 2007:2).

- **Access English language learners equitably**

It is also expected that Mathematics educators should help English language learners to access the language in an equitable way with English language speakers. Thus, ELLs are expected to show in the same academic standards as English speaking learners. Therefore, ELLs will have to demonstrate Mathematics knowledge without underestimating their abilities. This implies that tests and examination papers should be set without reducing the robustness of the subject matter (Kersaint, 2007:3). This also means that ELLs are capable of performing to the level of English speakers on condition that they are properly supported in class.

However, it is asserted that ELLs should go through a long process when they write tests and examinations. To make sense of the information, they should read the text in English first and translate it into their home language. They should then translate the information back to English to provide response and then take time to decide on the strategy to solve the problem. This process requires more time than is needed by their English speaking peers. Educators who are aware of this should provide more time for ELLs to complete tests and examination papers or reduce the number of questions (Kersaint, 2007:3). In South Africa, on the contrary, tests and examination papers for both English speakers and ELLs are allocated the same amount of time for writing. If educators' aim to improve Mathematics performance of learners, is of utmost importance to review time allocation for test and exam papers.

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- **Engage learners in classroom discourses**

Educators are also expected to engage ELLs in classroom discourses. Learners should be allocated ample opportunities to use the target language when deliberating on Mathematics problems. To achieve this, educators, themselves, should be familiar with the language and Mathematics development strategies of ELLs. The knowledge enables learners to showcase their skills as individuals and in groups (Kersaint, 2007:4). Most Mathematics educators, especially those who lack communication skills in English, however resort to giving learners copious notes on the board, while learners copy silently throughout the lesson. This is a challenge for the department because it keeps on taking educators for in-service training to improve their teaching approaches.

- **Teach vocabulary using realia and demonstration**

Furner, Yahya and Duffy (2005:16) recommend the use of realia to teach Mathematics and to demonstrate as best practices which educators can employ for the effective teaching of Mathematics. Educators can use concrete objects and manipulatives in demonstrating Mathematics concepts. Buchanan and Helman (2014:1) are also of the opinion that many ELLs are unfamiliar with the basic tools associated with Mathematics learning, such as rulers, protractors, calculators and computers and so on. Hence, learners need opportunities to make optimum of such tools.

Robertson (2009:5) claims that lack of familiarity with Mathematics vocabulary hinders comprehension of assignments. He proposes that learners should be taught multiple meanings of words, encouraged to offer bilingual support for each other, and provide visual cues, graphic representations, gestures, and pictures. Such practice makes comprehension easy and learning fun. This can help learners who have a phobia for Mathematics to develop interest in it.

- **Relate mathematics problems and vocabulary background and life situations**

Furner *et al.* (2005:17) stipulates that learning becomes easy when educators relate Mathematics problems and vocabulary to prior knowledge, background and daily life

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situations. Educators can implement this by prompting learners to talk about their experiences which are related to content. Learners can also be allowed to come up with the other methods they think can be used to solve Mathematics problems. By so doing, educators will address learners' needs and backgrounds, and link new knowledge to the old.

- **The use of graphic organisers and drawings**

It is also recommended that teaching Mathematics to ELLs should involve the use of graphic organisers and drawings to translate and visualise word problems. Bill (2005:35) asserts that graphic designers are helpful for ELLs because they show the relationship between Mathematical concepts and vocabulary. It also makes it possible to break down larger concepts into smaller parts. It includes the use of semantic webs, Venn diagrams, flow charts, compare and contrast charts, timelines, maps and other diagrams. Furner *et al.* (2005:17) also recommends the use of diagrams for ELLs who are at the beginning level of English language development stage in solving some Mathematics problems. The use of diagrams is used as a strategy that can be used to test learners understanding of concepts. This practice can alleviate frustrations for both educators and learners.

- **Encourage development of home language**

Ferlazzo (2012:3) encourages the development of home language in the learning of Mathematics in second language. Research has revealed that learning to read in the home language promotes reading achievement in the second language as transfer occurs. Educators are therefore, warned not to ban the use of the native language in the classroom. Similarly, Jarret (1999:4) purports that learners' home language plays an important role in Mathematics and Science learning regardless of whether the educator speaks the language or not. It is also claimed that, when learners are allowed to use their home language in the classroom, their academic performances, as well as English language development improve. It is further stated that Mathematics skills learned in the home language can be transferred and retained in the second language.

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It is concluded that learners achieve better in Mathematics and reading when their home languages are incorporated into instructional programmes.

In the researcher's point of view, the use of home language concurrently with the English home language should be reviewed by education planners. It is of utmost importance to determine how the two languages will be employed. In South Africa, the extent of the use of home language and English is determined by educators. There are educators who teach solely in English; some mix English and home language when they are teaching whereas some use the home language only in the teaching of Mathematics and other learning areas. However, all three groups claim that they use English as a medium of instruction.

- **Manage classroom discourses**

Mathematics educators are supposed to manage their classroom discourses by modeling their own speech in order to reach all learners. Educators can teach effectively when they communicate slowly, enunciate clearly, and use controlled vocabulary (using fewer pronouns) and simple language structures. They should avoid the use of idiomatic expressions; .and words with double meanings should be explained. It is also beneficial to provide learners with enough time to formulate the responses whether in writing or verbally. They take time as they think and process information in both mother tongue and English (Ferrazzo, 2012:2; Jarrett, 1999:17).

- **Use of con-living cues**

It was also realised that the use of non-linguistic cues can be helpful in teaching ELLs effectively. Educators should make use of visuals, sketches, gestures, intonation and other non-verbal cues to make language and content more accessible to learners (Ferlazzo, 2012:2). It is also recommended that during the course of the lessons, educators should sincere body expressions to endorse to impart content effectively.

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- **Journal writing**

Mathematics educators are also charged with the responsibility of encouraging and introducing ELLs to compile subject journals. Journals are meant to record important thoughts and thinking as an alternative assessment of learners' performances. Learners record their entries in English, but those who have limited linguistic skills can also write in their mother tongue or else seek assistance from their peers to write in English. Robertson (2009:8) regards journals as excellent for learners to enable them to process what they have learned and what questions they still have on the topic.

- **Check for understanding**

Educators are also advised to do regular checks to establish if learners understand the lesson or not. It is suggested that educators should develop communicative signs to confirm understanding. Learners can be orientated to use signs to confirm their understanding of the content, for example putting thumbs up, down or sideways. Learners should be urged to be honest when they do not understand or are unsure. Alternatively, educators can also ask learners to answer quickly on a post-it note to enable the educator to check responses. When educators regularly check for understanding in the classroom, students increasingly monitor their own understanding, and ensure that they are learning, thinking, and processing content. Educators are encouraged to do away with the tendency of simply asking learners if they have any questions. This is taken as an ineffective way of gauging learners' thinking (Ferlazzo, 2012:3).

Most educators are used to conducting chorus checks to confirm learners' understanding. In most cases, learners just agree that they understand. The reason is that they are shy, lack communicative skills to elaborate their misunderstanding, are scared of educators etc. As a result, sections are covered with very few learners who understand the matter. This is the reason why most learners are pushed through to Grade 12 without passing Mathematics.

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2.7 CONCLUSION

Through the discussion, it has become apparent that effective teaching and learning of Mathematics is based on the theories of learning that educators should employ in their lessons. However, in the South African context, the picture is gloomy because linguistic features are not highly considered by educators in class. This may partly explain why do not perform well in Mathematics. However, in the developed countries like the USA, Canada and Ireland learners receive support in Mathematics linguistic proficiency development. The education departments strive for improvement although this is not enough yet. The attitude and perception of educators towards the teaching of Mathematics in English have a lot of influence on the approaches they follow in the teaching process. It has transpired that educators should encourage learners to develop language proficiency for better performance in mathematics. The best practices which can be applied by educators to improve learning and teaching of Mathematics in English as a foreign language have also been outlined.

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CHAPTER 3

ENGLISH AS A LANGUAGE OF LEARNING AND TEACHING IN MATHEMATICS IN SOUTH AFRICA AND INTERNATIONAL COMMUNITIES

3.1 INTRODUCTION

This chapter outlines the provision of English second language as a language of learning and teaching in South Africa and in developed countries such as the United States of America, Canada and Ireland.

3.2 CURRENT SET UP IN SOUTH AFRICAN SCHOOLS

The current situation up in the teaching and learning of Mathematics in English as second language in South Africa can be discussed in terms of language in education policy and its implementation in schools. The situation also covers the choice of LOLT by parents, the level of proficiency of learners in LOLT, and code switching between mother tongue and English as LOLT. South Africa is a multilingual country with eleven official languages.

3.2.1 Language in Education Policy (14 July 1997)

South Africa is a multilingual country with eleven official languages. Language in education policy accommodates all the official languages to be used as languages of learning and teaching. Norvic (1996:1) purports that the education policy promotes home language education for the foundation phase, Grade 1 to 3. From Grade 4, English or Afrikaans is introduced. Lufer (2000:3) claims that, in the majority of black schools, about 99% choose English as a medium of instruction. Norvic (1996:1) also purports that about 80% of black South African learners are taught through English or Afrikaans as a medium of instruction. Most white, Indian and coloured children are

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taught in the same language of instruction, either in English or Afrikaans, from Grade 1 – 12.

Laufer (2000:3) reports that the language in education policy promotes continuation with the home language as a medium of instruction in the intermediate phase and secondary school. This implies that the policy does not restrict the use of the home language to the Foundation Phase only. Home language can be used as long as it is feasible. However, Norvic (1996:5) argues that the implementation of home language education in the foundation phase is fraught with some challenges in South Africa. The challenges are peculiar to respective province. For instance, in urban areas like Gauteng where a variety of languages are spoken, there is no common home language that can be used as a medium of instruction. Therefore, English is used as a medium of instruction.

Language in education policy also promotes the development and strengthening of the second language whilst the home language is being used. This model upholds dual medium of instruction. The policy subscribes to the view that learners benefit cognitively and emotionally from bilingual education (Laufer, 2000:4).

Despite the government's commitment to multilingualism and the promotion of language rights, the education sector does not reflect this multilingual nature. Parents prefer to have their children taught in English than in their home languages. All content subjects, including Mathematics, are taught in English (Royds & Dale-Jones, 2012:1).

Given that South Africa is a multilingual country, which promotes development and the strengthening of the second language whilst home language is being used, the researcher is of the opinion that, the dual medium of instruction is applicable and the most appropriate. Since learners are not exposed to English in their immediate environment, English should be supplemented with home language in the teaching and learning of Mathematics.

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3.2.2 Choice of LOLT by Parents

Laufer (2000:6) states that the language policy mandates parents to choose the language of learning and teaching on admission of their children at school. In case certain languages are not available at the school, parents may request the provincial department to make provision. The school governing body is mandated to determine the language policy in their respective schools. It is the duty of the school governing body to design programmes to promote multilingualism by using more than one language of instruction or by offering additional languages.

Olivier (2009:3) ascribes preference for English as LOLT to the following:

- Ensuring a successful financial and social future as an international language;
- Parents believing that job market demands proficiency in English
- Accessing both school and tertiary education in English
- Schools not having infrastructure and materials to offer more languages (African languages).

Zenex Foundation (2007:7) asserts that parents are in favour of English as a means of accessing economic resources. Learning through the home language is constrained by the fact that during apartheid, the language was negatively associated with everything inferior education. Dalvit (2009:10) also claims that, when prompted with a choice between English and African language as LOLT, most parents opt for English as they believe that it empowers their children. However, when they are well informed, they do not necessarily support the English policy. This implies that parents opt for English only as LOLT because they lack knowledge of its effects. This means that there is need to raise awareness of parents and SGBs' of language policy so that they can make informed decisions on the choice of medium of instruction. Furthermore, it is claimed that Mathematics register is only available in English and not in African languages, which still require development of technical terms.

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In the researcher's view, it is arguable that the eleven official South African languages are not equally developed to be used as media of instruction. For instance, all Mathematics books from Grade 4 onwards are written in English. This situation persuades parents to choose English as the most convenient language of instruction.

Dalvit, Murray and Terzoli (2009:40) stipulate that black learners are not trained well enough to use English as a medium of instruction before the shift to English takes place in Grade 4. It is claimed that there is a discrepancy between the vocabulary acquired by learners by the end of Grade 4. At this stage, black South African learners manage to accumulate a vocabulary of 800 words only whereas Grade 5 learners should have acquired 5000 words for effective learning. The high dropout rate of many learners in the rural areas and townships is attributed to poor proficiency in English as a medium of instruction.

3.2.3 Level of Proficiency in English as LOLT

Lewelling (1991:5) states that second language learners should be proficient to learn Mathematics successfully in English. He also claims that the minimum vocabulary to help them cope with English instruction is 5000 words. After four years of home language instruction in the foundation phase, and also learning English as a subject, a learner would have acquired only 800 words. Even after six years or more of learning Mathematics in an English speaking environment, second language learners will still be 10% disadvantaged through lack of understanding of Mathematics texts. Royds and Dale-Jones (2012:2) assert that almost 90% of South African black learners in Grade 4 could not read, while about 80% could not read in Grade 5. This is the reason why Grade 4 learners do not cope well in their studies due to a low level of English proficiency.

In the researcher's point of view, when the Department of Education realised that learners were not proficient enough to carry out their studies in English in Grade 4, the

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language in education policy was reviewed. From 2013, English was introduced as a subject from Grade 1.

Zenex Foundation (2007:7) purports that along with the continued use of the mother tongue, English should be introduced in the primary school curriculum so that children's language proficiency is built. This will fully prepare learners in the higher grades to cope with the use of English as LOLT. The amount of mother tongue teaching should be left to the discretion of provinces and school communities to decide.

The Zenex Foundation (2007:6) argues that the majority of learners in South Africa do not achieve age appropriate literacy levels in English. The reason is most learners do not have enough exposure to English either at home or at school to cope with learning. Hence, poor English language skills among learners and educators have been identified as one of the key factors that impact negatively on Mathematics results.

Similarly Ferreira (2011:103) states that, the majority of South African learners in secondary schools are mainly taught in English which is not the first language of either educators or learners. Proficiency in English as LOLT is regarded as one of the most factors that affect learners' performance. Unfortunately, English is used as LOLT for all subjects, including of Mathematics. As a result, educators face the double challenge of teaching Mathematics in English, while they are still learning the LOLT.

It is claimed that, since 1979, most South African learners were taught in English. However, it is striking that less than 25% of the black South African population has a reasonable competence in English (Dalvit, Murray & Terzoli, 2009:39). Some studies on English proficiency revealed that, depending on the definition of proficiency, learners' proficiency ranges from 32% to 62%. Although these figures refer to research conducted over decades, little has changed in the education system (Dalvit *et al.*, 2009:39). Fouche (2006:5) claims that only 12% of urban Black English second language learners that completed Grade 12 in 2004 were functionally literate and their language competency was equivalent to Grade 8 level in English. Literacy level of post

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graduate students was rated being far below the expected Grade 12 level (Ferreira, 2011:103). In the researcher's opinion, it is not surprising that there are many learners who cannot read both English and their home language throughout the school system. Such learners find it difficult to interpret Mathematics language, and most learners find it challenging.

In South Africa, there is a tendency of black middle class parents enrolling their children in white schools where they can learn English. The idea behind this is that learners will be successful in education like white learners and that they would have better opportunities in further education and future employment. However, there are some researchers who, on the contrary, claim that early switch to English as LOLT does not entail better academic performance (Dalvit *et al.*, 2009:38). Instead, they advocate for the late transitional bilingual would lead to academic success. It is cited that in the first phase of Bantu education, when the years of mother tongue were eight years, learners performed well. However, in the second phase, when the mother tongue was reduced to four years, there was a drastic drop in the matric pass rate in general, and Mathematics in particular (Dalvit *et al.*, 2009:38).

Inspite of the recommendation to promote additive bilingualism on LOLT, there has been little implementation (Probyn, 2006:393). This is despite the fact that the majority of learners do not have the necessary English language proficiency to successfully engage with the curriculum. Educators usually resort to using learners' home language to mediate understanding of the content in different learning areas. The poor English language skills of the majority of learners in township and rural schools mitigates against educators and learners adhering strictly to English. This implies that there is a gap between English learners' proficiency and the linguistic demands of learning through the medium of English (Probyn, 2006:393).

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3.2.4 Code Switching

In a research conducted in the Eastern Cape in South Africa, Probyn (2006:393) discovered that the extent of the use of home language in class depends on the educator's personal views. Code switching from English to home language is mostly used to explain new concepts, clarify statements or questions, emphasise points, and make connections with learners' contexts and experiences to maintain learners' attention, and also for classroom management and discipline (Probyn, 2006:393). The value of code switching, as an integral component of black South African communication patterns in both primary and secondary schools, is also recognised. It is regarded as a mechanism for ensuring learners' participation in class (Norvic, 1996:10).

The researcher supports the idea of code mixing for learners to have a better understanding of Mathematics. This is a strategy used by teachers so that learners cannot go astray in the learning process.

There are some researchers who are against code switching and the mixing of language for various reasons. For instance, the review of curriculum 2005 debate presented in PRAESA No. 6 (2000:30), it was revealed that learners are only exposed to English in formal settings in the classroom only. Although all schools are skewed towards the use of English as a medium of instruction. In practice, educators use the mother tongue during lessons. This is said to be the closest learners can get to the English medium. It is concluded that we are pretending to be using English as a medium of instruction. Under this condition it is stated that we are deceiving ourselves, and it removes us from the state of responsibility of educating young ones properly. It is expressed as a form of schizophrenia in which the truth is denied. The application of code mixing is attributed to the inflexibility of the brain to separate the two languages, thus it is believed that semi-English and semi-home language hinders the mastery of English (Huegh, 2000:130).

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Similarly, Probyn (2006:394) reports that many educators regard code-switching as a sign of failure rather than a legitimate classroom strategy. Educators are said to be smuggling vernacular into the classroom. This practice is said to have negative implications for the collection of authentic classroom data for research. Educators are likely to use less of learners' home language when they are observed in class. This implies that educators themselves are not comfortable using English that is why they are ashamed to be associated with the practice. For many township and rural learners, the oral language of the school and classroom is the learners' home language, whereas the language of reading, writing and assessment is English. The difficulty for many such learners is to bridge the gap and acquire proficiency in English and cognitive academic learning and meaningful engagement with the curriculum.

Ferreira (2011:105) reports that LOLT in South African classes is not English, but a mixture of English and mother tongue. It is purported that educators deliver chunks of content in English in textbook style, and then they switch to mother tongue for discussion and further explanation. Learners are often passive in class and they seldom engage in meaningful discussion in English. Educators are said to be under pressure to use English effectively in their lessons.

Dalvit *et al.* (2009:39) are also of the opinion that code switching is associated with poor quality education in South African schools system. Such association is said to be common in both rural and township areas. Therefore, the use of both English and African languages should be equally supported as the bilingual *de facto* reflects the practice in many rural and township schools.

It is further claimed that most African learners who write matriculation examination have been exposed to English as LOLT and the language of assessment for at least eight years. However, code-switching between English and learners' home language is the norm rather than the exception in rural and township schools. Educators interact with learners orally using an African language, while referring to English books and using English subject-specific terminology. In this situation, educators are caught in the

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dilemma of code-switching that is using learners' mother tongue to make communication possible while being aware that they have the responsibility to teach in English. Educators felt liberated when researchers endorsed the pedagogical value of code switching which they commonly use in the classroom (Dalvit *et al.*, 2009:37).

The researcher is of the opinion that, although code switching compensates for learners understanding of Mathematics, it should not be over-practiced. Doing so could result in learners getting disorientated in the use English as a medium of instruction. In such a situation, learners exonerate the use of English in their studies. However, the use of English for examinations makes a mammoth task which learners cannot surmount. Eventually, learners fail Mathematics due to failure to interpret the questions.

Moreover, it is also argued that, learners in rural area have little contact with English both within and without the school. It is speculated that this could be the reason why educators in rural areas express negative attitudes towards code-switching, since the classroom is the only domain where learners are exposed to English and have a chance to practice it. Another possible reason for low levels of English is that educators themselves are not proficient enough in the language of learning and teaching. In those circumstances, using English as the sole LOLT in rural areas and township schools is simply impractical (Dalvit et al. 2009:39).

Ferreira (2011:103) argues that trying to improve the quality of Mathematics education poses challenges for educators to pay attention to equip learners with necessary linguistic skills. It is recommended that teaching should go beyond basic vocabulary and impart knowledge of concepts. Learners should acquire LOLT skills that enable them to engage and manipulate discourses in Mathematics lessons.

Royds and Dale-Jones (2012:5) argue that children from all over the world are equally equipped with the potential for Mathematics, but South Africa is failing to harness this latent capability due to shortcomings in its implementation of language in education policy. Thus language in education remains a crucial issue to address in the

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transformation of the current dysfunctional education system, especially in the teaching of Mathematics. International perspectives provide valuable lessons and these are discussed next.

3.3 TEACHING AND LEARNING OF MATHEMATICS THROUGH ENGLISH AS LOLT IN THE DEVELOPED COUNTRIES

This section deals with situations in other countries where English is used in Mathematics as a second language of language of learning and teaching for foreigners. The researcher makes reference to the situation in the United State of America, Canada, and Ireland. The main aim is to find out if learners cope with their studies when they are taught in English.

3.3.1 United States of America (USA)

The education system in the USA is explained in terms of the English language learners' population, bilingualism, second language programmes, Proficiency in LOLT versus Mathematics learning, the comprehensible input theory, and approaches for teaching Mathematics.

3.3.1.1 English language learners' population

The USA claims to have experienced phenomenal growth in the number of English language learners over the first decade of the 21st century. The situation expands the need in many public schools to provide special language instruction programmes for learners to enable them to cope with their studies. Supporting English language learners (2009:2) reports that there are about 5 million English Language Learners in public schools in the USA, which translates to more than 10% of the school population. California, for instance, has 25% of learners who are English language learners (ELL). In Texas, New York, Florida, Illinois and Arizona there is a substantial number of ELLs. In the South Eastern United States, the ELL population increased by 200% in the last ten years. Urmario (2014:1) argues that the school going age children who speak

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languages other than English at home are the fastest growing population in the USA. He claims that they make up 21% of the school going children, which translates to 4.7 million. The burgeoning numbers of ELL pose unique challenges for education to provide to learners and to the curriculum in schools so that they could acquire academic knowledge and English language skills (Education Week Spotlight, 2004:2).

3.3.1.2 Bilingualism

Robertson and Summerlin (2005:5) assert that bilingual learners in the USA differ in their level of proficiency. There is also a challenge of learners born in the USA who often develop conversational language abilities in English, but lack academic language proficiency. While they are new comers, ELLs need to develop both conversational and academic language skills. Those who were born there need to develop academic skills to cope with different learning disciplines. Educators are obliged to evaluate literacy status of learners on admission.

3.3.1.3 Proficiency in LOLT versus Mathematics learning

It is claimed that it takes learners with the lowest skill levels five to seven years to become proficient in English. However, there were learners who had been in the USA schools for more than six years and yet they had not reached English proficiency that would enable them to cope with the curriculum (Armario, 2014:2).

Masqueda and Tellez (2008:415) report on how English language Latino learners cope with their studies in Mathematics. They start off by refuting the long standing myth that the level of English proficiency of learners is not an issue of instruction because Mathematics is a universal language. They assert that English learners play a critical role in the learning of Mathematics. It is claimed that English proficiency enables learners to comprehend content so that they are able to apply it in Mathematical concepts.

However, the poor performance of Latino learners in Mathematics suggests that meeting the linguistic and academic needs of learners is a critical issue in learning

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Mathematics. It is also noted that the language of Mathematics is more complex than everyday English language. The Department of Education in Latino areas recognises that ELLs should be proficient in everyday conversational English and complex Mathematics to succeed in their studies. The low level of English proficiency is considered to be a deficit, and, as such, ELLS have limited access to advanced Mathematics courses in higher education (Masqueda & Tellez, 2008:416).

Crouch (2012:2) is also of the opinion that both ELLS and English language speaking learners need intensive support to succeed academically. However, those whose mother tongue is not English face more challenges in their studies. The challenges are reflected in their academic performance, which has always remained lower than that of other learners. For instance, the results from the 2011 National Assessment of Education progress reflected a substantial gap between the scores of ELLs and home language speakers of English in both reading and Mathematics in fourth and eighth graders alike. Education Week Spotlight (2004:4) also claims that, nationwide, only 5% of Grade 8 learners achieved in Mathematics in 2009 compared to 35% of non-ELLs. Furthermore, the NAEP reading test percentage of ELLs who reached proficiency was lower than the Mathematics test scores in both 4^{th} and 8^{th} graders. Only 3% of ELLs met the standard in Grade 8 reading, in 2009, compared to 34% of non-ELLs.

Underperformance of ELLs in most disciplines, like Mathematics, raised a concern and calls for education to conduct research in identifying strategies to improve both the English language proficiency and academic performance. Some advocates for ELLs considered the implementation of the common core academic standards to be adopted in almost every state in order to raise the achievement of ELLs. It involved consideration of ELLs' proficiency tests for the common standard to measure annual progress in reading, writing and speaking. The state had to also comply with the 'No Child is Left Behind Act', of 2001. The school districts were required by law to meet targets set by their states for adequate yearly progress of ELLs or else they faced sanctions.

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Regulations for the law stipulate that ELLs must be tested in Mathematics when they enter the USA. Reading tests follows after a year. In 2007 and 2008 only 11 states met the accountability goals for ELLs according to the analysis of federal data by the Washington-based American Institute for Research. When the issue continued to surface in the discussion, President Obama spoke publicly of the value of bilingualism for learners to succeed in their studies (Education Week Spotlight, 2004:5).

Garrison and Mora (1999:34) write that statistics in Mathematics achievement show that Latino learners are significantly under-presented in all scientific and engineering careers. The under-performance is said to be in direct proportion to the standard of Mathematics required for a particular job. In other words, it means that most of the Latino learners fail to meet the admission requirements in scientific and engineering fields at tertiary level. The underperformance of learners in Mathematics is attributed to the misconception among educators that since Mathematics uses symbols, it is ideal when instructing second language learners. Thus, the misconception ignores the vital role of language in the development of Mathematics concepts. This results in unreasonably high expectations for learners' achievement in which learners receive no linguistic support. However, the dilemma faced by ELLs Mathematics educators is to make the curriculum accessible to learners.

3.3.1.4 Comprehensible input theory

It is claimed that there are some educators who believe that the concept "development" occurs naturally when learners are fluent in the language of instruction. However, most Latino learners face the challenge of covering new concepts. It is recommended that one of the key elements in teaching Mathematics to ELLs effectively, is the application of what Krashen terms comprehensible input. This construct was developed to describe language that is understandable and meaningful under optional conditions. Comprehensible input is supposed to be provided in the school context through certain planned strategies which include the use of concrete contextual references and lack of restrictions on the use of learners' primary language. The principle of i+1 is regarded as the basis for specially designed Academic Instruction in English called the Sheltered

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English instruction which is recommended for ELLs. The sheltered instruction includes a set of strategies used to adapt content area materials for English language learners. This strategy is recommended for Latino learners to enable them to succeed in their studies in Mathematics learning (Garrison & Mora, 1999:36).

3.3.1.5 Effects of BICS and CALP

Robertson and Summerlin (2005:13) claim that Latino ELLs are likely to underperform in Mathematics due to their low standard of proficiency in Basic Interpersonal Skills and Cognitive Academic Language Proficiency. Hence, it is claimed that ELLs have to be taken through instruction to acquire both Basic Interpersonal Communication skills and Communication Academic Language Proficiency skills in order to cope with Mathematics studies. It is further purported that, for learners to extract meaning from content, they should have a functional grasp of Mathematics register and vocabulary. Moreover, it is claimed that ELLs also have some challenges with syntax. This includes correspondence between conventional symbols and their verbal expressions as well as lacking the ability to solve word problems.

3.3.1.6 Approaches for teaching Mathematics

Garrison and Mora (1999:36) argue that, with Latino children, bilingualism is practiced with the belief that there is common underlying language proficiency that facilitates the transfer of learning between home and second language. The transfer of learning is believed to take place when a certain threshold of proficiency is attained in the second language.

Another bilingual strategy employed in the teaching of Mathematics to ELLs in the USA is the preview review. In this context, new content is initially introduced and explained in the learners' native language and later presented and reinforced in the second language (English). The technique transfers comprehensible input for ELLs and establishes skills and concepts, in order to facilitate the transfer of learning from home to second language (Garrison & Mora, 1999:36).

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It is claimed that the main challenge for educators is to stimulate ELLs to develop Mathematics reasoning application of taught concepts and to engage learners in the active expression of the second language in the process of instruction. Mathematics literacy is considered to be crucial in the development of Mathematics reasoning and understanding. The proposed framework for constructing meaningful lessons is the Second Language Approach to Mathematics (SLAMS). SLAMS has two strands, that is one focusing on Mathematics content while the other one emphasises on related linguistic skills (Robertson & Summerlin, 2005:13).

3.3.2 Canada

The provision of Mathematics in English as second language in Canada is discussed in terms of the English language population and programmes.

3.3.2.1 English language learners' population

People for Education (2011:1) states that, in Ontario, there are English and French schools, and in both systems, there are learners who need language support to succeed in their studies. It is also reported that, over the years, there has been a steady increase in the number of ELLs in Ontario schools. About 250 000 immigrants migrate to Canada every year. Most of them settle in Central Canadian Provinces, of which Ontario is the most popular of the 10 provinces in Canada. Ontario is the most linguistically and culturally diverse province. There are therefore some ELLs who migrate from all over the world, but some were born in Canada and raised in families or communities in which other languages other than English were spoken. In secondary schools where there are ten or more ELLs, 95% have a specialist educator for ELLs.

The diversity of population in Ontario classrooms has helped to shape the language policy that promotes good outcomes for English language learners. The department has noticed the need for learners to learn the medium of instruction, in order to meet curricula needs in English schools. The Department of Education also supports the idea that learners should acquire outcomes for ELLs as they graduate from school and

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further their studies at tertiary level. The language acquisition policy is designed to help ELLs by engaging them to develop their talents, meet learning goals, and acquire knowledge and skills that would enable them to contribute in Ontario's society. The ministry of education works in collaboration with community partners and other ministries to enhance opportunities for success in the teaching and learning process (Ontario Ministry of Education, 2007:7).

3.3.2.2 English language learners programmes

The whole of Ontario Province operates consistently to educate ELLs across the province. School boards are mandated to meet school needs while the ministry provides the school boards with direction and support in meeting the needs of ELLs. The main aim is to develop in learners, proficiency in English which is necessary for success in school. The policy assists the boards in meeting the needs by defining who ELLs are, what the procedure for reception, orientation, placement and programs for ELLs should be, in order to accelerate the acquisition of English for academic success. The policy also outlines assessment programmes, defines the role of educators and administrators and also provides opportunities for them to develop their skills to support ELLs. The procedures for collection of data for ELLs and for monitoring and tracking their progress are spelt out (Ontario Ministry of Education, 2007:8). In the researcher 's view the language in education policy is good in the sense that it identifies ELLs and also supports schools in the development of learners' English skills to enable them to cope with their studies.

The school boards provide subject educators with the opportunities for professional development to meet the needs of ELLs. Educators assigned to ELLs and English language development programmes at elementary and secondary school levels are required to hold English as a second language part one qualification. Educators with positions of added responsibility in the area of ESL are required to obtain a specialist certificate in English as a second language (Ontario Ministry of Education, 2007:22).

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It is claimed that ELLs develop proficiency that supports academic success in English within a year or two. At this stage, learners can follow classroom instructions and maintain simple conversation about familiar topics and routines. However, it takes longer for ELL to catch-up to their age peers in the academic language. The board should design programmes and services in consultation with the community partners about English second language and literacy (Ontario Ministry of Education, 2007:22).

The Ontario Ministry of Education (2008:3) claims that, although ELLs come from different linguistic backgrounds, they should find themselves in a welcoming and supportive environment. Learners are helped to adjust and integrate into new culture while they are learning a second language and content. Research suggests that it takes learners 2-7 years for learners to acquire language proficiency. Educators teach English across the curriculum to facilitate language development and content. Educators provide academic support to bridge the gap between previous schooling and performance expectations. Learners from poor linguistic backgrounds are paired with those who are more proficient in English, in order to provide them with peer tutoring.

Learners are grouped into second languages stages of English proficiency. The terminal goal of each stage provides guidance to assist educators in the development and the modification of the curriculum for ELLs in Grade 3, 6 and 9 levels. In stage one, learners demonstrate the use of English for conversational purposes. In stage two, learners demonstrate the use of English to support familiar activities. In stage three, learners demonstrate independent use of English in most contexts, while in stage four, learners demonstrate facility in English approaching that of first language speakers. The grouping ensures appropriate support for ELLs to meet the curriculum needs in each and every learning area.

In secondary schools, learners who require language, support face limits beyond simple language acquisition. Data from the Education Quality and Accountability Office show that ELLs are 36% more likely to be enrolled in applied Mathematics than in pure Mathematics. Applied Mathematics puts learners at a disadvantage of not being

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admitted at university level. The situation raises concerns because enrolling in applied courses limits post secondary choices in higher education (People for Education, 2011:1). However, the province has effective strategies to support learners to enable them to reach provincial standards of academic proficiency in both English and French. The support is rendered to prevent learners from streaming into applied courses due to language related challenges. (People for Education, 2011:2).

The discussion on the Canadian system is meant to show how other countries take the trouble of planning for the development of English skills for effective learning. It has become apparent that, ELLs receive support from various stakeholders so as to be effective across the English second language curriculum. The situation depicts that, even if there are good plans for learners to develop linguistic skills, learners still have some challenges due to lack of proficiency. This is a challenge, which means that, if learners do not have enough support, they can hardly cope with their studies.

3.3.3 Ireland

The situation in Ireland on the provision of Mathematics in English is explained in terms of LOLT in the country, Mathematics performance in relation to LOLT, bilingualism, Mathematics performance and proficiency in LOLT.

3.3.3.1 LOLT in Ireland

Ireland does not have an explicit national language in education policy. However, both Irish and English are compulsory subjects for primary and junior learners in the post primary schools. There is no obligation to study in a foreign language although, in practice, the majority of learners study in the foreign language (English) to leaving certificate level. Thus, there is a considerable number of both primary and secondary school learners who study all subjects in the medium of Gaeilge and who face imminent transition from English medium education at either second or third levels. This is happening in spite of the fact that learners are encouraged to use Irish as a medium of

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instruction. The department also provides support for the implementation of Irish (Department of Education, 2005-2006:3).

3.3.3.2 Mathematics performance in relation to LOLT

In a study which was conducted to investigate the extent to which performance in Mathematics could be attributed to language of instruction, Riordain and Donoghue (2006:1) concluded that:

> *The use of English as a language of learning and teaching leads to difficulties arising in Science, Engineering, Technology subjects and Mathematics in particular. The challenge of learners to cope with Mathematics learning is more prevalent at the key Stages of transition in education, from primary to secondary and from secondary to Tertiary. Learners have the option to transfer to learning through English at second level, whereas English medium is a norm at third level. Learners are submerged to learn Mathematics in English* (Riordain & Donoghue, 2006:2).

The study also revealed that examination papers were criticised in June 2006 at both primary and leaving certificate levels for the use of an awful lot of language as opposed to the use of symbols. This situation is a barrier for learners whose English is not their home language. The use of more English language in the question paper was meant to assist learners to achieve better understanding of Mathematics tasks. However, the strategy also had adverse effects on learners who were not competent enough in English as a language of instruction. It was realised that the language fluency allows learners to communicate Mathematical findings properly, whereas without it, learners are restricted in their development (Riordain & Donoghue, 2006:2).

From the study, one can deduce that, ELLs are disadvantaged by complicated language in examination question papers. The given situation shows that verbose language is difficult and confusing for ELLs. This is conscientizing educationists that the standard of language of question papers can contribute to the performance of learners.

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3.3.3.3 Bilingualism in Ireland

It also transpired that the issue of learning and teaching in second language has been studied extensively in other countries like the USA, Canada, South Africa, Australia and the UK. In these studies, the two main language learning contexts have been identified as the submersion and immersion programmes. The programmes lead to subtractive and additive bilingualism when the majority language replaces a minority language. The same happens when learners from the Irish district transfer to learning through the medium of English. In the case of additive bilingualism, the mother tongue of learners is the majority language and they opt to study through a second language which is a minority language. This applies to Irish learners who prefer to study in Irish (Riordain & Donoghue, 2006:30).

In the researcher s' point of view, those second language learners who opt to use English as LOLT when they can learn in Irish, experience learning difficulties. Such learners compromise the standard of mother tongue, while they are also not good in English. They end up underperforming in learning areas offered in English. Those who use Irish as a medium of instruction, however, are proficient in both English and Irish and they are likely to outperform the former group in different learning areas.

3.3.3.4 Mathematics performance in relation to LOLT

The report also claims that there are conflicting views about learning Mathematics in a second language at all levels of education system. Some studies claim that there is a positive correlation between learning Mathematics in a second language and academic achievement. Conversely, other studies show that in submersion programmes, second language learners underachieve in Mathematics. The point was confirmed in an Irish study which was carried out by McNamara in 1996. The study revealed that learning through a second language (English) hinders the learning progress in Mathematics learning in Ireland. (Riordain & Donoghue, 2006:4).

The underperformance of ELLs is attributed to the link between learners' proficiency in their first language and second language and cognitive development. This is supported

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by language learning theories. The most prominent one is the Threshold Hypothesis. The theory states that, competence in both first language and second language determines benefits of learning in a second language. It is asserted that balanced bilinguals perform better in Mathematics than monolinguals (Riordain & Donoghue, 2006:4).

The linguistic challenges on under-performance of ELLs in Mathematics are also attributed to the development of Basic Interpersonal Communication Skills and Communication Academic Language Proficiency. What is important to take note of is that, while second language learners pick up the oral proficiency in Basic Interpersonal Communication Skills), in the new language (English) in two years, it takes up to seven years to acquire the decontextualised language skills (Communication Academic Language Proficiency) necessary to function in a second language classroom. The challenge experienced in Ireland is that, most learners do not perform well in Mathematics due to lack of proficiency. Learners need intensive academic support to acquire such CALP to succeed in their studies (Riordain & Donoghue, 2006:5).

3.3.3.5 Proficiency in LOLT

Riordain and Keeffe (2012:1) state that communicative proficiency in the language of instruction is significant in a learning context. However, there is also a need for learners to also acquire academic proficiency in the language of instruction, which is defined as a specialised form of language used in subjects like Mathematics. Educators are, therefore, advised to take cognizant of their role of supporting learners to gain academic proficiency in the language of instruction, be it English or Irish. Educators are advised to guard against tensions that arise between Mathematics and language, formal and informal language, learners' home language and the official LOLT. Tension arises from classroom practice focusing on developing learners' Mathematical understanding. (Riordain & Keeffe, 2012:1).

Mathematics terminology was also found to be a primary source of difficulty for ELLs when they transfer from learning through Gaeilge to learning through English in all

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subjects. In this case, progress is said to be hindered by failing to understand basic Mathematics operations like addition, subtraction, and so on, which are fundamentals that learners should learn through Gaeilge from primary school level. ELLs also experience some problems associated with the structuring of Mathematics problems. Learners find it difficult to pick out the important information needed to respond to Mathematics questions (Riordain & Donoghue, 2006:5).

3.3.4 Analysis of South Africa and International Communities in Teaching Mathematics in English

The researcher has realised that the USA, Canada, and Ireland are very advanced in the programmes for advancing and developing the teaching of Mathematics and the entire curriculum in the English second language. Learners' linguistic skills are tested on arrival in the new country so that learners could be provided with appropriate support. However, even if ELLs are accommodated in the special programmes, learners still have some challenges in their studies, both at school and tertiary level.

South Africa, however does not have special programs to support ELLs. The development of learners' linguistic skills is expected to be developed by educators. Unfortunately, Mathematics educators in secondary schools do not pay much attention to Mathematics linguistic features; they only teach content. English educators only concentrate on general linguistic skills which do not develop academic skills. Hence, ELLs experience serious challenges that impact negatively on learners' performance in Mathematics. It is, therefore, not surprising that South Africa always comes last in the international assessment of Mathematics performance.

Howie (1999:45) claims that Mathematics education has traditionally been procedure based for decades. Hence, the international Mathematics reform has placed more emphasis on literacy competences. The shift has influenced both pedagogy and curriculum expectations and has also increased the overlap between literacy skills and Mathematics learning in instructional practice. This implies that South Africa still has to

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address the gap between linguistic skills and Mathematics delivery to enable learners to be competent at a global stage.

3.8 CONCLUSION

The chapter discusses the current South African setup on the use of English as a LOLT in the teaching of Mathematics. The situation reflects that, the education system has not been properly equipped to assist ELLs to develop competence in the learning of Mathematics. The school governing bodies are expected to choose the language of teaching and learning, but they lack information to do so. The support provided to learners by educators is limited because they are not trained to teach Mathematics in English as a second language. Hence, learners do not perform well in the subject. On the contrary, the situation in developed countries such as the USA, Canada, and Ireland is different. ELLs experience minimal difficulties as compared to South Africa in the learning of Mathematics. The developed countries have intensive plans to support learners to cope with the study of Mathematics in English second language. The international perspectives provide lessons from which South Africa can learn.

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CHAPTER 4

RESEARCH PARADIGM, DESIGN AND METHODOLOGY

4.1 INTRODUCTION

The purpose of this study was to investigate the influence of English as a language of learning and teaching on the performance of high school learners on Mathematics in Vhembe District. This chapter outlines the research paradigm, research design, methodology and the sampling process. Attention is also given to credibility (reliability, validity, trustworthiness, and transferability.

4.2 RESEARCH PARADIGM

Research paradigm refers to a philosophical framework that guides the study (Corbin & Strauss, 2008:1). Maree (2007:47) describes paradigm as a set of beliefs about elements of reality which give rise to a world view. The researcher understands it to be a philosophical basis which underpins a study. It provides lenses through which a research study can be viewed.

The choice of a research methodology is guided by the research paradigm that hinges on a particular study. The following philosophical dimensions distinguish research paradigms: ontology, epistemology and methodology. Ontology refers to the theory about the nature of reality or what can be known about it. It is about the perception of what things really are and how they work together. Epistemology is the relationship between the one who knows and the known. Epistemology also relates to an understanding of the source of knowledge and how it is acquired (Huff, 2009:108; Maree, 2007:48). Methodology is a research plan which lies behind the choice of methods used. It is concerned with the process and procedures in which data are obtained and analysed (Scotland, 2012:28).

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These ontological and epistemological dimensions contribute in delineating research paradigms. Three main research paradigms are positivism, anti-positivism and critical theory, which, in practice, can take the form of pragmatism. This study adopted positivism and anti-positivism research paradigms, a combination known as pragmatism.

Pragmatism advocates and values the use of both qualitative and quantitative designs (Denscombe, 2008:7; Creswell & Clarks, 2014:43). The combination or mixing of qualitative and quantitative methods, processes and procedures is encouraged, in order to have a deeper understanding of the phenomenon under investigation.

4.3 RESEARCH DESIGN

The study adopted a mixed methods design. The design adopts both qualitative and quantitative methods in a single study. Johnson, Onwuegbuzie and Turner (2007:119) define mixed methods research as a design in which the researcher collects, analyzes and integrates both quantitative and qualitative data in a single study or a multiple program of inquiry. In a similar vein, (Gray, 2009:204) defines a mixed methods as the collection and analysis of both quantitative and qualitative data in a single study. Thus data are collected concurrently or sequentially, and it involves integration of data at one or more stages in the process of research.

Many reasons can be considered for the use of mixed methods in a single study. However, for the purpose of this study, the researcher has considered four justifications for combining both methods in a single study adopted from (Creswell,1994:175 and Bryman,2006:106) as follows:

- **Triangulation**

Creswell (1994:175) claims that triangulation seeks convergence of results of research. Bryman (2006:106) states that triangulation seeks convergence, corroboration of results from quantitative and qualitative data.

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- **Complimentarity**

Creswell (1994:175) purports that overlapping of quantitative and qualitative methods and different facets of phenomenon may emerge through research process. On the other hand, Bryman (2006:106) is of the opinion that complimentary seeks elaboration, enhancement, illustration, clarification of results from one method with the results from another.

- **Initiation**

It is claimed that initiation seeks to discover paradox and contradictions, new perspectives of frameworks, the recasting of questions or results from one method to another (Creswell, 1994:175 and Bryman, 2006:106).

- **Expansion**

Both Creswell (1994:175) and Bryman (2006:106) claim that, mixed methods approach extends the scope and breadth of enquiry to the study by using different methods for different components of enquiry.

The researcher also support Hesse-Biber and Levy (2006:307) who claim that combination of quantitative and qualitative methods create a synergistic research project whereby one method enables the other to be more effective and together both methods provide full understanding of the research problem.

4.4 RESEARCH METHODS

The study adopted qualitative and quantitative methods for collection of data.

4.4.1 Qualitative Research Methods

The researcher used the face to face semi-structured interview to collect data. The interview was conducted with curriculum advisers to find out the success of teaching Mathematics through English as LOLT. The use of structured interview was preferred

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because it creates a chance for the researcher to notice and correct the respondents' misunderstandings, to probe for inadequate or vague responses, thereby helping the researchers gain meaningful data. Furthermore, a semi-structured interview was preferred on the grounds that the researcher can establish rapport and motivate the respondents to answer fully and accurately in order to improve the quality of data (Judd, Smith & Kidder, 1991:218).

Another positive aspect for the use of the structured interview is its flexibility, in the sense that additional questions may be asked as new issues arise and this results in the gathering of in-depth information (Gray, 2009:373). Furthermore, a structured interview comprises open-ended questions through which one can collect in-depth information by probing. Kumar (2011:150) claims that, in situations where in-depth understanding is required, the structured interview is one of the suitable methods of data collection.

The interview protocol was prepared to inform the respondents about the research details such as the purpose of the study, keeping and using of data, and time allocation for the interview session.

4.4.2 Quantitative Research Methods

Surveys in the form of questionnaires were used to collect quantitative data. The questionnaires were administered to high school Mathematics educators and learners.

The use of questionnaires in this study was done on the grounds that it would permit greater anonymity, which would help to increase the likelihood of obtaining accurate information. Moreover, questionnaires afford ample time for the respondents to consider questions before answering. Furthermore, questionnaires elicit large amounts of information from a large number of respondents in a short period of time.

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4.5 SAMPLING PROCESS

This section addresses the population, sampling procedures and the sample.

4.5.1 Population

The population for the research comprised of all educators who taught Mathematics in secondary schools, all secondary school learners who offer Mathematics as a subject, and all Mathematics curriculum advisers in secondary schools in the Vhembe District.

4.5.2 Sampling Procedures

I used both qualitative and quantitative sampling procedures to select the respondents.

4.5.2.1 Qualitative sampling procedures

The researcher used convenience non-probability sampling in the selection of the respondents. It is a sampling technique in which subjects are selected because of convenience accessibility and proximity to the researcher (Berg, 2001:32). Thus, curriculum advisers were selected for inclusion in the sample based on their availability at the time the interview was administered. The sampling procedure was appropriate as the availability of curriculum advisers was not predictable. They are often deployed all over the district.

The sampling was considered because it is easy to carry out, and has few rules governing how the sample should be selected. Moreover, the relative cost and time required to carry out convenience sampling are reasonable. It, therefore, enables the researchers to achieve the sample size in a relatively fast and inexpensive way.

4.5.2.2 Quantitative sampling procedures

Simple random sampling was used in the selection of both educators and learners' samples. Bailey (1987:87) understands simple random sampling as a form of probability

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sampling in which all subjects in the population have equal probability of being selected for the sample. The sampling procedure was preferred because each individual has a chance to be selected. Hence, it permits the generalisation from sample to the population it represents. The sampling procedure was adopted because it is simple and accurate in the selection of sample.

Four Mathematics educators were sampled from four big schools with the enrolment over a thousand each. However, two educators were sampled from small schools with less than a thousand learners. In cases where educators were more than the target sample, a lottery system was used in the selection of the sample. Each member of the population was assigned a unique number. The numbers were then thoroughly mixed in a bowl and shaken. Then, without looking in the bowl, the researcher selected numbers. The educators whose numbers were picked from the bowl were included in the sample.

For learners, a list of Grade 11 and 12 learners was sought from the respective schools in Mvudi Circuit and these were used in the selection of the sample. The class lists were picked randomly. The researcher pointed randomly at the list to determine the starting point. Thereafter, numbers were picked at intervals of 10. The process continued until 20 learners had been picked from each big school with more than a thousand learners, and 13 learners from each small school.

All learners who were registered for Mathematics in secondary schools had a chance to be selected. The researcher requested for a list of learners who registered for Mathematics as a subject from the target schools. The names were arranged alphabetically and they were allocated numbers. The researcher picked the first number randomly. The subsequent participants were selected at intervals of 10 until the required number of participants was reached.

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4.5.3 Sample

Both qualitative and quantitative samples were identified as follows:

4.5.3.1 Qualitative sample

Four curriculum advisers who play supportive roles in the teaching of Mathematics in the Vhembe District schools were interviewed. Curriculum advisers are responsible for orientating Mathematics teachers to new teaching strategies. They also conduct in-service training and workshops for teachers, set and moderate assessment, compile year plans, and organise cluster meetings. They monitor written work and curriculum coverage. They ensure that teachers have necessary support materials and encourage schools to share the resources and ideas, as well as compile and analyse diagnostic reports in an attempt to support teachers to improve the quality of teaching.

4.5.3.2 Quantitative sample

The quantitative sample comprised of 24 Mathematics educators selected from eight secondary schools in Mvudi Circuit and 132 high school Mathematics learners.

4.6 DATA ANALYSIS AND INTERPRETATION

Data analysis was carried out both qualitatively and quantitatively.

4.6.1 Qualitative Data Analysis

Qualitative data was analysed using qualitative content analysis. The approach was employed on the interview data. Hsieh and Shannon (2005:278) define qualitative content analysis as a research method for the subjective interpretation of the content of data through systematic classification processes of coding and identifying themes and patterns. On the other hand, Mayring (2000:2) describes qualitative content analysis as an approach of empirical, methodological controlled analysis of text within their context of communication, following content analytic rules and step by step models, without

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rash quantification. The interpretive method was opted for the grounds that it pursues understanding of the phenomena. Kohlbacher (2006:6) understands qualitative content analysis to be approach to document analysis that emphasises the role of investigator in the construction of meaning of text. There is emphasis on emergence of categories out of data and recognising the significance for understanding the meaning of text.

Content analysis was employed, in this research, to allow the researcher to understand social reality in a subjective but scientific manner (Mayring, 2014:3). Another strength of qualitative content analysis relative to other interpretation methods resides precisely in the fact that analysis is resolved into individual steps of interpretation which are determined in advanced. Analytical steps make the whole analysis, process comprehensible. Another strength of content analysis, which was considered, is that it can be virtually unobtrusive. Moreover, the materials needed for conducting research are easily and inexpensively accessible (Berg, 2001:258).

Weed (2005:10) defines interpretive analysis as an approach which focuses on interpreting life experiences of interviewees and represents the world view from interviewees' perspectives. Smith and Osborn (2007:53) claim that the aim of the interpretive method is to explore, in detail, how participants make sense of their personal and social world. The approach is said to be phenomenological because it involves a detailed examination of participants' life world, and it attempts to explore personal perceptions or accounts of events.

The interpretive approach was utilised because the presentation of qualitative content analysis results strives for a balance between description and interpretation of data. Interpretation represents one's personal understanding of the phenomenon under study. Sufficient interpretation allows the reader to understand the description.

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4.6.2 Quantitative Data Analysis

Quantitative data were analysed using the Statistical Package for Social Sciences (SPSS) version 20 computer software. Data were analysed considering the frequency distribution of responses and these were translated into percentages. SPSS was used in the counting of frequencies of the responses of both educators and learners. The frequencies were presented in the form of tables, graphs, and charts to simplify the interpretation of data. The software was used to obtain descriptive statistics. The null hypotheses tests were conducted with Binomial and chi-square tests. The null hypotheses were either retained or rejected based on the significant level of the data.

4.7 MEASURES OF QUALITY CONTROL

Trustworthiness was considered as a measure of control for qualitative data. Validity and reliability was used to validate the instruments for quantitative data collection instruments.

4.7.1 Trustworthiness

Trustworthiness relates to the rigour of the research study which generates trust and confidence in the findings. It is a measure of the quality of the research (Thomas 201:318). Trustworthiness includes credibility, transferability, dependability and confirmability.

- **Credibility**

Credibility refers to the validity of the study. It measures the extent to which the study measures what is actually intended. It is concerned with the accuracy of believability of outcomes of research (McMillan & Schumacher, 2010:102). To ensure credibility of the study, the researcher used to established methods of data collection (mixed). The mixed methods added value to the triangulation of data. Furthermore, the right participants with relevant information were identified.

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- **Transferability**

Transferability is concerned with the ability of the results of a study to be applied to other research contexts (Leed & Omrod, 2014:105). Thus, the results can be applied to a wider population. To ensure transferability, random sampling was used in the selection of participants. Moreover, the use of thick descriptions in the analysis of qualitative data brought out full details for the understanding of the phenomenon.

- **Dependability (Reliability)**

Dependability is the extent to which the results reflect the views of the participants and not those of the researcher (Thomas, 2010:315). Participants used in the study are knowledgeable in the area of study. The selection of sites also ensured the collection of the right information. The use of a tape recorder also helped in member checking and confirmation of the transcribed data. The study also reviewed related literature of some researchers who conducted studies in the same phenomenon. The researcher also provided evidence in the form of quotations from transcripts from interviews with curriculum advisers. The use of codes and themes on the transcribed data also helped in demarcating categories of data.

- **Confirmability**

Confirmability relates to objectivity of the study. It is the degree to which the research findings are the product of the form of enquiry (Babbie and Mouton, 2001:56). To ensure confirmability, the researcher described the methods used in the study in detail for the audit trail. Moreover, the use of research assistants enabled the researcher to share views. This helped in the triangulation of data and prevented biasness in ideas.

4.6.2 Validity and Reliability of the Quantitative Research

Quantitative data were tested for validity and reliability. Validity and reliability tests are regarded as primary criteria for the evaluation of quantitative research. These two concepts are referred to as psychometric properties of research (Phelan and Wren, 2005:1).

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- **Validity**

Validity is regarded as the strength of conclusions, inferences, or positions. It refers to the extent we measure what we hope to measure and what we think we are measuring (Key, 1997:1). Content validity was used as a measure to test that the questionnaires measure what they were intended to measure. This was done by ensuring that every single questionnaire item was addressed by the literature review.

- **Reliability**

Phelan and Wren (2005:2) and Key (1991:2) define reliability as the degree to which an assessment tool produces stable and consistent results. The Cronbach's alpha test was conducted to check the reliability of the questionnaire. According to Key (1991:2), the values around 0.7 and 0.8 are good for reliability tests. The reliability tests performed yielded the results as follows:

	Component	No. of Items	Cronbach Alpha
1	The attitudes and perceptions of educators in offering Mathematics in English as a language of learning and teaching.	17	0.720
2	Learners' challenges	I5	0.638

The Cronbach's alpha test reflected high reliability values of 0.720 for the attitudes and the perceptions of educators in the teaching of Mathematics in English. The Chronbach's alpha test of learners' challenges in the learning of Mathematics in English reflected a somewhat reliability value of 0.638. These two values of 0.720 and 0.638 are in agreement with Key's argument that questionnaires were reliable

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4.8 ETHICAL CONSIDERATIONS

To observe ethics pertaining to research practice, there was a need to seek permission from the district authorities to conduct research with the curriculum advisers. An application letter was personally delivered to the office before embarking on the research process. Permission to conduct research with learners and educators in schools was sought with the manager of Mvudi and Mutale circuits, as well as the managers of the respective schools where the research was conducted. Application letters were personally delivered to the offices by the researcher and an ethical clearance was sought from the research and innovation office at the University of Venda.

The study upheld the research ethics of privacy and confidentiality, informed consent, anonymity, respondents' welfare and voluntary participation. The confidentiality norm is in line with Gray (2009:78) who claims the right of privacy and confidentiality as one of the basic tenants in the democratic South African society. To achieve the norm requirements, questions were framed within the ambit of the target topic.

An overarching principle observed was that, the respondents were provided with the informed consent form to complete in order to be part of the study. They were made aware that their participation was voluntary and that they were in no way, coerced into participation in the study. Furthermore, they were informed that they were at liberty to withdraw from the study if they so decided.

Participants were also assured that collected data would be kept safe in a locked cupboard to prevent other people, who are not involved in the study, accessing it. It was also necessary to apply a fundamental technique of removing identifiers (information on names, telephone numbers, e-mail addresses etc) from data files when they were no longer in use. The names of schools and informants were replaced with pseudonyms to protect their identity.

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4.9 CONCLUSION

The research design and methodology provided the study with a chronological plan which specified the way in which the research was executed, in order to address research questions. This section carries a significant influence on the reliability of the outcomes of the study. The chapter, therefore, provided a solid base for the whole study. The researcher made sense of data by using qualitative content analysis and the SPSS.

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CHAPTER 5

DATA ANALYSIS AND INTERPRETATION

5.1 INTRODUCTION

This chapter presents both qualitative and quantitative data analysis and interpretation. The chapter, it has been divided into two sections as follows: qualitative and quantitative data analysis, and interpretation. The qualitative data comprised of data collected from four curriculum advisers who were interviewed. The quantitative data were collected from 20 Mathematics educators and 132 Mathematics learners who responded to the questionnaires.

5.2 QUALITATIVE DATA ANALYSIS: CURRICULUM ADVISERS' INTERVIEW

This section covers presentation and analysis of the curriculum advisers' interview data. As mentioned in Chapter 1, the study investigated the influence of English as a language of learning and teaching on the performance of high school learners in Mathematics. Data were divided into biographical information, which provides background information of the respondents, and the content information.

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5.2.1 Biographical Information Analysis

Table 5.1: Biographical Information Analysis

Total Number of Participants	4		100%
Gender	Males	4	100%
	Females	0	-
Average age (in years)	40		
Range of the highest academic qualification	Honours to Masters		
Experience as Mathematics Curriculum Adviser (in years)	11		
Professional training to teach in second language	Yes	0	-
	No	4	100%

Interview data were collected from four Curriculum Advisers. All of them were males. They were all 40 years and above in age. The academic qualifications of the participants ranged from honours to masters. The experience of the respondents as Mathematics curriculum advisers ranged from 11 to 20 years. (See graphs in appendices).

5.2.2 Content Information Analysis

This section presents analysis of curriculum advisers' responses to interview questions. The responses were consolidated into themes. All the curriculum advisers responded to all six questions:

5.2.2.1 How can Proficiency in the language of learning and teaching be developed to teach Mathematics?

The following summarises the curriculum advisers' responses:

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- **Language teachers support**

Curriculum advisers believe that proficiency in the language of learning and teaching can be developed if Mathematics teachers are supported by English teachers. This means that English teachers and Mathematics teachers should work together in identifying and teaching concepts that need to be developed so that learners can understand the Mathematics content. One pointed out that, Mathematics teachers and English teachers should work hand in hand to develop proficiency in English. The other claimed that, English teachers can support Mathematics educators by including Maths terminologies in assignments and essay writing.

- **Development of basic English communication skills**

They pointed out that Basic English Communication Skills should be developed in the teaching process. One claimed that, "It is better to develop simple English language skills because Maths does not really need complicated language". This means that Mathematics teachers should teach simple language skills so that learners can communicate mathematically with ease. With simple language skills, it is believed that learners will be able to deal with word problems and questions which need interpretation skills.

- **Development of Scientific terminology**

Curriculum advisers also believe that proficiency in the language of learning and teaching can also be developed by developing understanding of mathematical terminologies. This can be done by both Mathematics teachers and language teachers. It was suggested that language teachers should give learners some tasks which cover Mathematics terminology.

- **Relating English to Mathematical language**

Another point which emerged is that Mathematics educators should relate ordinary English language to Mathematical language, especially concepts which have different meanings in English and Mathematics. For instance, the expression "in addition" has different meanings in ordinary English and in Mathematical language. This also applies

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to the teaching of translation from English to symbolic notation. For example, when we say equal to, learners should also be introduced to the symbol so that they can get used to it. One claimed that, educators should assist learners to translate from Mathematical language to ordinary English and vice versa.

5.2.2.2 To what extent do learners understand Mathematics textbooks?

Curriculum advisers generally believed that learners find it difficult to understand Mathematics textbooks on their own. One stated that learners fail Mathematics even if they have textbooks. The reason is that the Mathematical language is complicated for learners to comprehend. The claim stands even if the new books are presented using a simple approach which suits to the level of learners'. Books are said to be adapted to simple spoken language and they contain a lot of illustrations and activities, yet learners still find them difficult to understand. That is the reason why learners prefer to use notes given by teachers during lessons. This is why learners do not even carry textbooks to school because they do not depend on them. However, it is recommended that learners should be assisted by educators to understand books. Thus, it is necessary for educators to go through textbooks to introduce learners to Mathematical language and reading skills.

5.2.2.3 How well do learners respond to questions which require interpretation in Mathematics?

Curriculum advisers were agreed that questions which require interpretation in Mathematics are challenging for high school learners. The reason advanced is that learners fail to interpret questions due to lack of proficiency in the language of learning and teaching (English). Learners are reluctant to express themselves in class and to air their views. They also claimed that some learners go to the extent of not answering interpretive sections while most of them respond poorly to such questions in examination. Hence, the performance in interpretive questions is not satisfactory. It was also indicated that even the yearly Grade 12 Mathematics diagnostic reports reflect poor performance of learners in interpretive questions. One curriculum adviser stated in vernacular and English that, *Zwine vha vhona kha Gireidi 12 hu tshi ḓa problem dzi no*

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ṱoḓa interpretation in Mathematics, vha ya vha na thaidzo. They do not do well in those questions. The statement means that even Grade 12 learners have challenges in responding to interpretive questions.

5.2.2.4 How does home language proficiency contribute towards the mastery of Mathematics concepts?

The respondents reflected different views on the question. Some claimed that home language does not contribute towards the mastery of Mathematics. The reason advanced is that learners in the high school are not taught in their mother tongue. It is further speculated that even if Mathematics was taught in the learners' mother tongue, there would be no improvement in learners' understanding. It was also pointed out that if learners were taught in home language, they would perform much better in Mathematics. Reference was made to countries like Japan where learners are doing well in Mathematics because they are taught in their mother tongue. The respondents were however, against code mixing English and home language since they believed that it does not enhance understanding in Mathematics. One of the respondents claimed that it is not necessary to switch to Tshivenḓa because there are no words in Tshivenḓa to explain Mathematics.

5.2.2.5 How do Mathematics teachers address learners whose conceptual development in Mathematics is below the expected standard?

- **Diagnostic test**

The curriculum advisers stipulated that learners whose conceptual development in Mathematics is below grade level can be helped by giving them diagnostic tests to identify individual challenges. Identification of challenges would enable educators to assist learners on individual basis.

- **Extra Classes**

Extra-classes were recommended for learners to enable them to catch up with conceptual understanding. They argued that extra-classes can be conducted outside the contact time during extra-classes in the afternoon and vacation classes. It is

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claimed that extra tuition improve performance in Mathematics when they are taught at a slower pace. Hence, it is recommended that extra classes should not only focus on covering syllabus but also closing the content gap created in the previous classes. One curriculum adviser emphasized that, *Na rine ri vha encourager zwenezwo zwauri extra lessons dzi songo vha dzi khou ṱoḓa u covera syllabi, dzi vhe dzi khou sedzesa content backlog because there is a problem kha Mathematics.* This means that, educators should conduct extra-classes with the aim of closing the content gap rather than covering syllabi. It was suggested that educators should slow down the teaching pace to enable learners to understand the content better.

- **Closing content gap**

Curriculum advisers claim that most learners progress through the grades in the high school without passing Mathematics. This is due to the content gap they experience throughout the grades. They strongly advised that Mathematics teachers should always refer back to the previous grade subject matter before they introduce new content in their teaching. They should build content from the lower classes. The practice is recommended even in further education and the training phase. However, curriculum advisers indicated that due to time factor, educators are unable to cover the content gap from the previous grades. Educators are mainly concerned about going along with the pace setters to cover the syllabus. Hence there is need for extra-classes to improve learners' performance.

5.2.2.6 Mathematics classes tend to attract very few students, why is this the case?

- **Attitude towards Mathematics**

The responses revealed that most learners have a negative attitude towards Mathematics. Mathematics is perceived as a difficult subject because its knowledge is cumulative through the grades. Once learners fail to master some basics in the lower classes, it is difficult to follow it in the higher grades and learners end up discouraged to do Mathematics and develop a negative attitude towards it. One curriculum adviser

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asserted that Mathematics is considered as the most difficult subject, and that it is more difficult when the foundation is weak.

- **Choice between Mathematics and Mathematical Literacy**

It is commonly believed that the choice between the two subjects is influencing learners to shift from Mathematics to Mathematical Literacy. Learners believe that Mathematical Literacy is easier than pure Mathematics.

- **Educators' Influence**

Curriculum advisers also argued that, since there is a shortage of Mathematics educators in South Africa, some educators encourage learners to do Mathematical Literacy. One curriculum adviser stated that teachers encourage learners to do Maths literacy because they believe that Mathematics is difficult. Moreover, there are some educators who discourage learners from doing Mathematics by telling them that not all learners are intelligent enough to understand Mathematics. They also stated that educators should motivate learners to develop a positive attitude towards Mathematics. It is suggested that educators should prove to learners that Mathematics is not difficult, and that it is just confusing if the basics are not firm enough to cope with it.

5.3 QUANTITATIVE DATA ANALYSIS

This section focuses on the analysis of data collected from educators and learners. Analysis of data was done considering the frequency distribution of responses which were translated into percentages. The impact of the investigated aspects were determined by the percentages of those who agreed or disagreed. To determine the percentage of the responses, the total number of those who agreed and strongly agreed was added together and translated into percentages. The same applied with the disagreed and the strongly disagreed responses. Descriptive statistics were used to describe the basic features of the quantitative data. It provided simple summaries about the sample and measures. Together with simple graphic and table presentations the analysis formed the basis of the quantitative analysis.

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5.3.1 Educators' Questionnaire

This section focuses on the analysis of data collected from educators.

5.3.1.1 Biographical information of educators

Table 5.2: Biographical Information of Educators

Total number of participants	24		100%
Gender	Males	15	62,5%
	Females	9	37,5%
Average Age (in years)	41		
Current work position range	CS1 educators to principals		
Highest academic qualification range	Diploma to honours		
Professional training to teach in second language	No	5	20,83%
	Yes	18	75%
	Missing	1	4,16%
In service training attendance	No	6	25%
	Yes	18	75%
Support by Curriculum Advisers in Mathematics	No	1	4,16%
	Yes	22	91,66
	Missing	1	4,16%
Mother tongue	Venda	16	66,66%
	Other languages	8	33,33%
Language they conduct sustainable conversation in	English	21	87,5
	Other languages	10 (South African languages)	41.66%
Mathematics workshop attendance	Never	1	4,16%
	Yes	22	91,66%
	Missing	1	4,16%

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The study involved 24 Mathematics educators of whom 15 were males and nine were females. The participants had an average age of 41 years. The current position held by the participants ranged from being CS1 educators, Heads of departments, deputy principals and principals. Thus, all Mathematics educators were considered regardless of the positions they held in the school system. Most of the participants (16) were Venda speaking while eight spoke other South African languages, Tsonga (4), Ndebele (2) and others (2). This was expected because the study was conducted in Thohoyandou, which is dominated by Venda speakers. Participants were asked which languages they were capable of sustaining a conversation in. 21 participants indicated that they are proficient in English and some other 10 South African languages.

The respondents' highest academic qualifications ranged from diplomas to honours level. Out of 24 respondents, six claimed that they had not attended in service training in Mathematics, 18 claimed to have attended, however one did not respond. The question whether the participants are supported by curriculum advisers in Mathematics was asked. One claimed not to have support, 22 admitted that they have been supported and one did not respond. There was need to find out how often the respondents attended Mathematics workshops. Those who did not attend and those who attended once were not credited, and they were six in number. Those who attended more than twice were 17, while one did not respond.

5.3.1.2 Content analysis of educators' questionnaire

Content information was predominantly backed up by graphs and tables. To minimise the number of choices in the responses, the agreed and the strongly agreed were grouped together and disagree and strongly disagree were also grouped together and the responses translated into percentages. The statements in this section highlight some challenges that learners are likely to encounter in the learning of Mathematics in English as a language of learning and teaching.

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Table 5.3: Explanation of Complex Mathematical Concepts is Challenging

	Frequency	Percentage
Agree	16	66.6
Disagree	6	25
Non-response	2	8.3
TOTAL	24	100

Sixteen (66,6%) respondents indicated that explaining of complex Mathematical concepts is challenging, six (25%) did not agree with the statement, and two (8,3%) did not respond. It is conclusive that due to the use of English as a language of learning and teaching, educators find it difficult to come to the level of learners' understanding when teaching complex concepts.

Table 5.4: Learners are Likely to Participate in Mathematics Discussion Conducted in English

	Frequency	Percentage
Agree	14	58.3
Disagree	7	29.1
Non-response	3	12.5
TOTAL	24	100

Fourteen (58,3%) respondents indicated that learners are likely to participate in Mathematics discussions, seven (29,1%) claimed that learners do not participate, while three (12,5%) did not respond to the questions. Those who are in support of the statement were in the majority at 58,3%. One can, therefore, conclude that learners are generally not afraid to communicate in English even if it is a foreign language.

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Table 5.5: Learners who use English as a Language of Learning and Teaching Pose Clarification Questions during Lessons

	Frequency	Percentage
Agree	16	66.6
Disagree	6	25
Non-response	2	8.3
TOTAL	24	100

Sixteen (66,6%) participants agreed that learners who use English as a language of learning and teaching ask questions for clarification of concepts, six (25%) did not agree with the statement and two (8,3%) did not respond. Those who agreed with the statement were in the majority, proving that learners feel free to communicate in English.

Table 5.6: Learners who use English as a Language of Learning and Teaching have a long Listening Span in Mathematics

	Frequency	Percentage
Agree	15	62.5
Disagree	7	29.2
Non-response	2	8.3
TOTAL	24	100

Fifteen (62,5%) agreed with the statement, seven (29,2%) did not agree with it and two (8,3%) did not respond. Most responses were in agreement that learners who use English as a language of learning and teaching have a long listening span.

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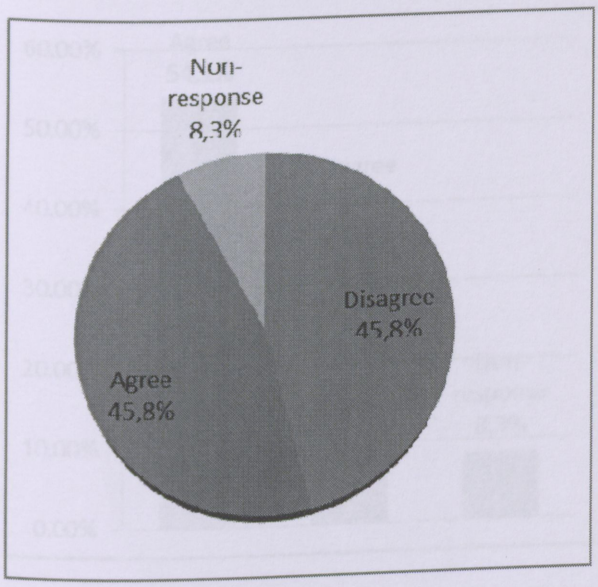


Figure 5.1: Most Learners are Proficient enough to Understand Mathematics Content in English

Agree	11	(45,8%)
Disagree	11	(45,8%)
Non-response	2	(8,3%)

Eleven (45,8%) claimed that most learners are proficient enough to understand Mathematics content in English, 11 (45,8%) did not agree with it while two (8,3%) did not respond. Those who agreed with the statement and those who disagreed were equal in numbers. The fact that such a large number of learners is struggling to understand Mathematics content is a great cause for concern.

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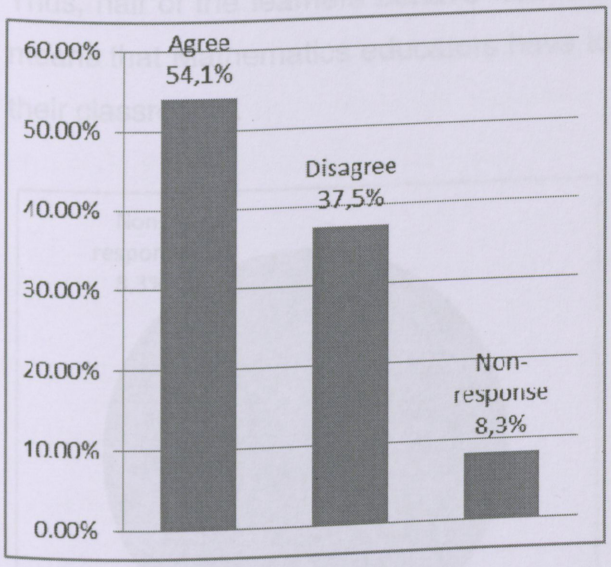


Figure 5.2: Learners who use English as a Language of Learning and Teaching are Likely to Perform well in Mathematics

Agree	13	(54,1%)
Disagree	9	(37,5%)
Non-response	2	(8,3%)

Thirteen (54,1%) agreed that learners who use English as a language of learning and teaching are likely to perform well in Mathematics, nine (37,5%) opposed the system, and two (8,3) did not respond. More than half of the respondents believe that learners perform well in Mathematics when they are taught in English.

Table 5.7: English Language Learners are Likely to behave in Class

	Frequency	Percentage
Agree	10	41.7
Disagree	10	41.7
Non-response	4	16.7
TOTAL	24	100

Ten (41,7%) respondents agreed that English language learners are likely to behave well in class, 10 (41,7%) disagreed while four (16,7%) did not respond to the question.

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Thus, half of the learners behave well while the other half does not behave well. This means that Mathematics educators have to be firm in order to have effective learning in their classrooms.

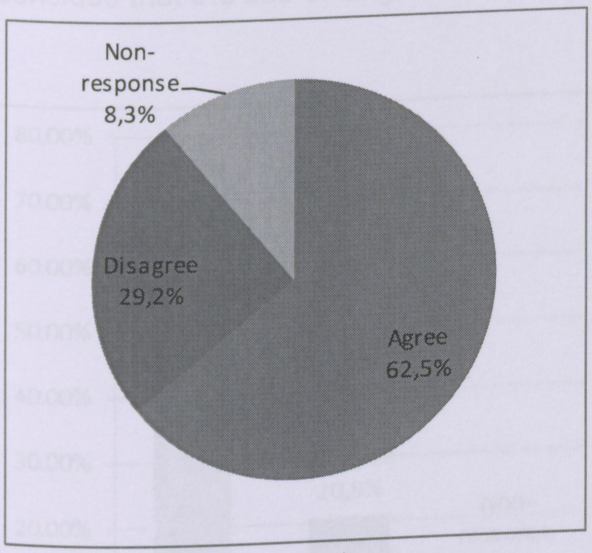


Figure 5.3: Learners who use English as a Language of Learning and Teaching Participate during Mathematics Lessons

Agree	15	(62,5%)
Disagree	7	(29,2%)
Non-response	2	(8,3%)

Fifteen (62,5%) respondents agreed with the statement, seven (29,2%) did not agree and two (8,3%) did not respond. Most educators are in schools where learners actively participate in class. One would, therefore, expect the learners to perform well in the subject

Table 5.8: The use of English as a Language of Learning and Teaching Speeds up Teaching and Learning Pace in Mathematics Classes

	Frequency	Percentage
Agree	15	62.5
Disagree	6	25
Non-response	3	12.5
TOTAL	24	100

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Fifteen (62,5%) agreed with the statement, six (25%) disagreed and three (12,5%) went did not respond. Since the responses were skewed in favour of those who agreed that the use of English speeds up the teaching and learning pace one can, therefore, conclude that the use of English as LOLT is effective.

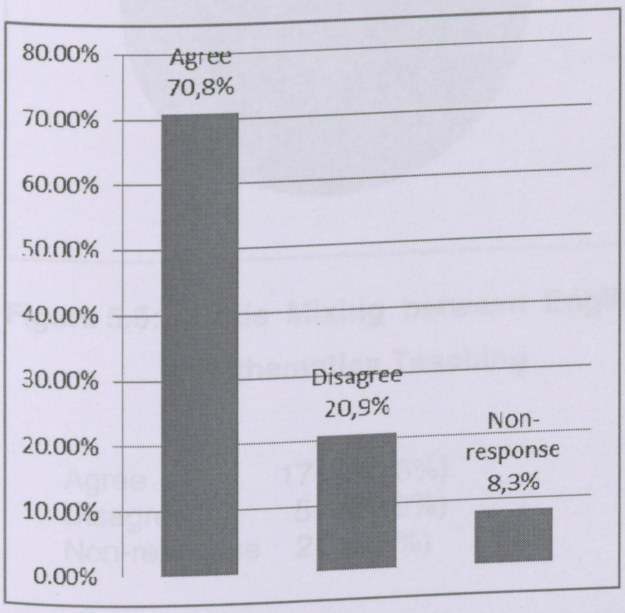


Figure 5.4: It is Possible to Focus on Language and Content Development in Mathematics Instruction

Agree	17	(70,8%)
Disagree	5	(20,9%)
Non-response	2	(8,3%)

Seventeen (70,8%) of the respondents agreed that it is possible to focus on language and content development in Mathematics instruction, five (20,9%) disagreed and two (8,3%) did not respond. The highest percentage gave a positive response, supporting that it is possible to teach Mathematics concurrently with development of language aspects.

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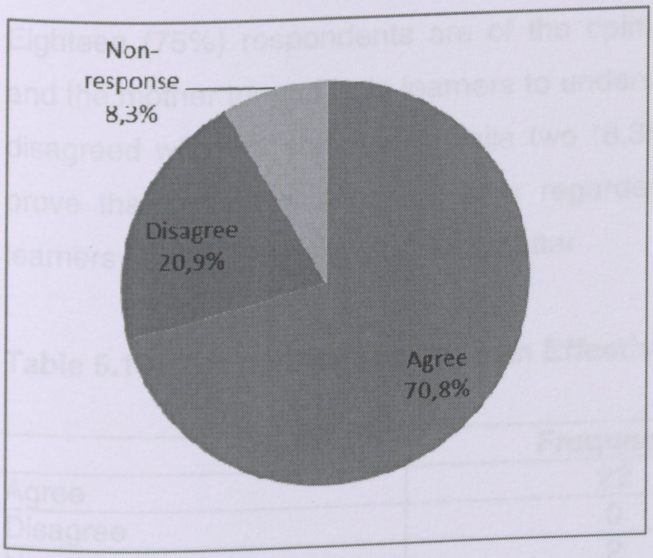


Figure 5.5: Code Mixing between English and Home Language is Effective in Mathematics Teaching

Agree	17	(70,8%)
Disagree	5	(20,9%)
Non-response	2	(8,3%)

Out of 24 respondents, 17 (70,8%) agreed that code mixing between English and the home language is effective in the teaching of Mathematics, five (20,9%) did not agree with the statement and two (8,3%) did not respond. The highest percentage agreed that most of the teachers code mix English and the home language to help learners to understand Mathematics.

Table 5.9: Code Switching between English and Mother Tongue Enforces Content Understanding in Mathematics

	Frequency	Percentage
Agree	18	75
Disagree	4	16.7
Non-response	2	8.3
TOTAL	24	100

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Eighteen (75%) respondents are of the opinion that code switching between English and the mother tongue help learners to understand Mathematics content. Four (16,7%) disagreed with the statement, while two (8,3%) did not respond. The figures clearly prove that code switching is highly regarded by Mathematics educators in helping learners to understand the subject matter

Table 5.10: Group Discussion is an Effective Teaching Approach in Mathematics

	Frequency	Percentage
Agree	22	91.7
Disagree	0	0
Non-response	2	8.3
TOTAL	24	100

Twenty-two (91,7%) respondents were in favour of the statement, no one disagreed, but two (8,3%) did not respond to the question.

Table 5.11: Learner Centred Approach is Effective in the Teaching of Mathematics in English

	Frequency	Percentage
Agree	20	83.3
Disagree	1	4.2
Non-response	3	12.5
TOTAL	24	100

Twenty (83,3%) were in agreement with the statement, one (4,2%) disagreed, and three (12,5%) did not respond. As the highest percentage agreed with the statement, it, therefore, goes without saying that the learner-centred approach is effective in the teaching of Mathematics.

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Table 5.12: Oral Testing during Lessons Enforces Understanding of Mathematics

	Frequency	Percentage
Agree	22	66.7
Disagree	6	25
Non-response	2	8.2
TOTAL	24	100

Out of 24 participants, 16 (66,7%) agreed with the statement, six (25%) disagreed and two (8,2%) did not respond. Most of the educators prefer oral testing in the teaching process.

Table 5.13: Learners are Likely to Understand Mathematical Linguistic Aspects

	Frequency	Percentage
Agree	16	66.6
Disagree	6	25
Non-response	2	8.3
TOTAL	24	100

Sixteen (66,6%) of the respondents agreed with the statement, six (25%) disagreed while two (8,3%) did not respond. Thus majority of the participants support that learners cope with their studies in Mathematics.

Table 5.14: Extra-lessons Improve Learners' Performance in Mathematics

	Frequency	Percentage
Agree	21	87.5
Disagree	1	4.2
Non-response	2	8.3
TOTAL	24	100

Twenty-one (87,5%) respondents agreed with the statement, one (4,2%) disagreed, whereas two (8,3%) did not respond. This implies that most Mathematics educators prefer conducting extra-classes to improve learners' understanding of Mathematics.

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5.3.1.3 Null hypotheses test of educators' questionnaire

The null hypotheses test was conducted to test the significance of the questionnaire. Inferences were drawn using the chi-square test. The significant value determines whether the hypothesis should be retained or rejected. The decision followed the guidelines that, when the significant value of the test is equal or more than the value of 0,05 the hypothesis is retained. However, when the significant value of the test is less than the value of 0,05 the null hypothesis is rejected. The results of the null hypotheses test were presented in a tabular form as follows:

Null Hypotheses Summary

Item	Null Hypothesis	Test	Sig	Decision
1	The category of the attitudes and perceptions of educators towards teaching Mathematics in English occur with equal probabilities.	Chi-square	0..008	Reject the null hypothesis

The hypothesis was: *Educators have positive attitudes and perceptions towards teaching Mathematics in English.*

The resultant null hypothesis was: *Educators have negative attitudes and perceptions towards teaching Mathematics in English.*

The significance value of the test was 0.008, which is less than 0.05, hence the null hypothesis was rejected

The rejection of the null hypothesis implies that teachers have a negative attitude towards teaching Mathematics in English.

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5.3.2 Learners' Questionnaire

The section deals with analysis of data collected from learners

5.3.2.1 Biographical information analysis

Table 5.15: Biographical Information Analysis

Total Number of Participants	132		100%
Gender	Males	51	38,63%
	Females	81	61,36%
Average age (in years)	16		
Field of study	Sciences	111	84,09%
	Commerce	15	11,36%
	General	6	4,54%
Mathematics performance in the last quarter	Performing	98	74,24%
	Underperforming	34	25,75%
Target Mathematics pass percentage	Performing	128	96,96%%
	Underperforming	4	3,03%
Mother tongue language	Venda	121	91,66%
	Other languages	11	8,33%

The study involved 132 learners, of whom 51 were males and 81 females. Participants were from 16 years of age and above. Learners, at this age are either in Grade 11 or 12. One hundred and eleven participants were registered in the science stream, 15 in commerce and six in the general group.

The performance of the respondents in Mathematics in the last quarter shows that 98 learners performed well, while 34 underperformed. The targeted performance in the end of year results in Mathematics shows that 128 learners expected to perform well

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while only four admitted that they are not going to make it. The situation shows that, generally, learners expect to perform well in Mathematics, but the actual performance is unsatisfactory. Participants are predominantly Venda speaking (121) while 11 spoke other South African languages.

5.3.2.2 Content analysis of learners' questionnaire

Content information was supported by graph and table presentations. To minimise the number of choices in responses, the agreed and the strongly agreed were also grouped together and disagree and strongly disagree were grouped together in percentage. The questions, in this section sought to reveal the challenges that learners associate with Mathematics and which make them lose interest in the subject.

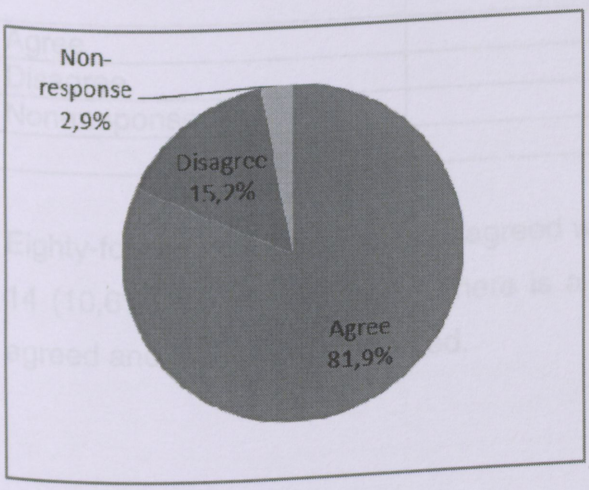


Figure 5.6: I Follow Mathematics Presentation in English

Agree	109	(81,9%)
Disagree	20	(15,2%)
Non-response	4	(2,9%)

Out of 132 participants 108 (81,9%) agreed with the statement, 20 (15,2%) disagreed, and four (2,9%) did not respond. This implies that most learners believe that they are proficient enough to understand lessons presented in English.

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Table 5.16: I Learn Mathematics through Memorisation

	Frequency	Percentage
Agree	61	46.2
Disagree	65	49.2
Non-response	6	4.6
TOTAL	132	100

Sixty-one (46,2%) participants agreed with the statement, 65 (49,2%) disagreed, while six (4,6%) did not respond. Those who agreed and those who disagreed were almost the same number.

Table 5.17: I am Proficient in Interpersonal Communication Skills

	Frequency	Percentage
Agree	84	63.6
Disagree	34	25.7
Non-response	14	10.6
TOTAL	132	100

Eighty-four (63,6%) respondents agreed with the statement, 34 (25,7%) disagreed while 14 (10,6%) did not respond. There is a vast gap between the number of those who agreed and those who disagreed.

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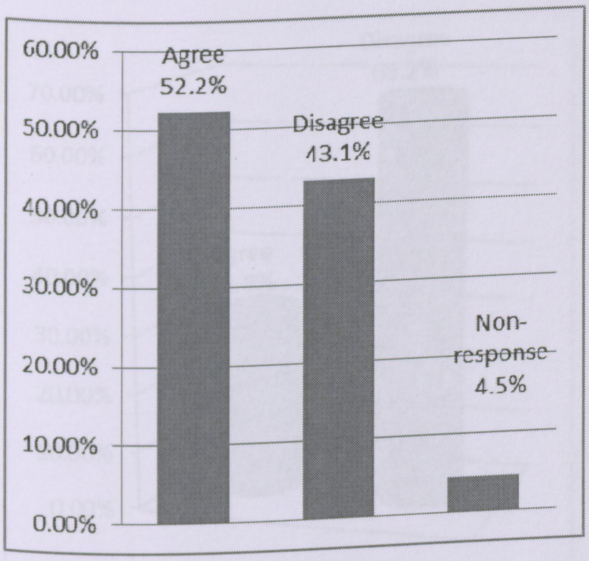


Figure 5.7: I Participate in Group Discussions Conducted in English

Agree	69 (52,2%)
Disagree	57 (43,1%)
Non-response	6 (4,5%)

Sixty-nine (52,2%) participants agreed with the statement, 57 (43,1%) disagreed, whereas six (4,5%) did not respond.

Table 5.18: I have a long concentration span in the Mathematics class

	Frequency	Percentage
Agree	75	56.8
Disagree	48	36.3
Non-response	9	6.8
TOTAL	132	100

The responses show that 75 (56,8%) learners agree with the statement, 48 (36,3%) disagreed and nine (6,8%) did not respond. Most learners claimed that they has a long concentration span.

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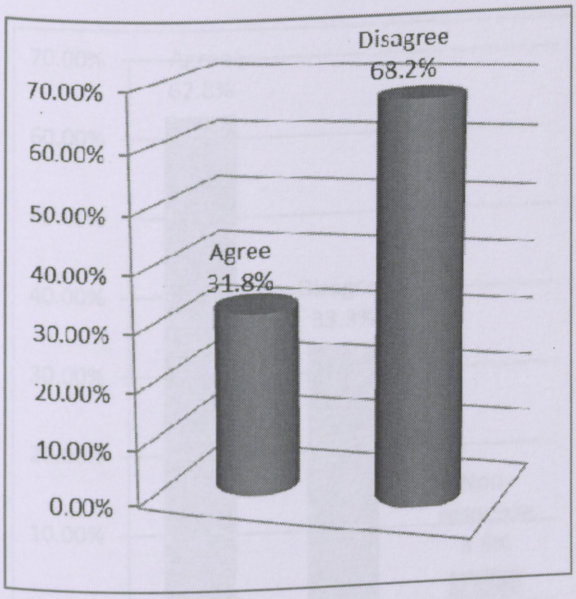


Figure 5.8: I Communicate in English in Mathematics Class without Fear of Making Mistakes

Agree	41 (31,8%)
Disagree	88 (68,2%)

From the total of 132 learners, 41 (31,8%) were in favour of the statement and 88 (68,2%) were not in favour of the statement. Thus, most learners do not feel free to communicate in English out of fear of breaking the language of teaching and learning.

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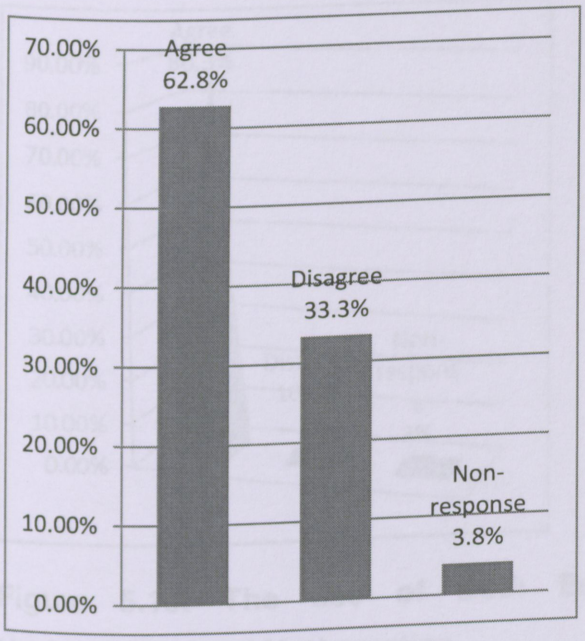


Figure 5.9: I Prefer Copying Notes in Mathematics Class than Responding to Questions

Agree	83 (62,8%)
Disagree	44 (33,3%)
Non-response	5 (3,8%)

Eighty-three (62,8%) learners indicated that they prefer taking notes in class to responding to questions whereas 44 (33,3%) did not support the statement while five (3,8%) did not respond to the question. This means that, most learners do not find it easy to respond to questions verbally. Hence, they resort to taking notes than to responding to questions in class.

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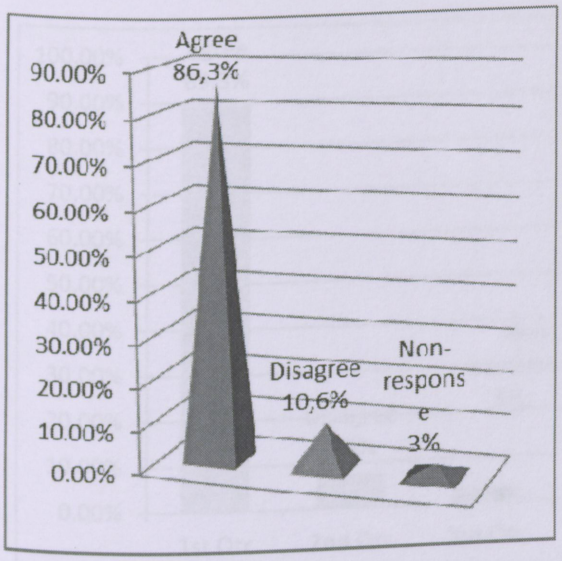


Figure 5.10: The use of Both English and Home Language Enforces Understanding of Mathematics

Agree	114 (86,3%)
Disagree	14 (10,6%)
Non-response	4 (3%)

One hundred and fourteen (86,3%) learners were in favour of the statement, 14 (10,6%) did not agree, and four (10,6%) did not respond. The responses show that the highest percentage preferred the use of both languages in Mathematics.

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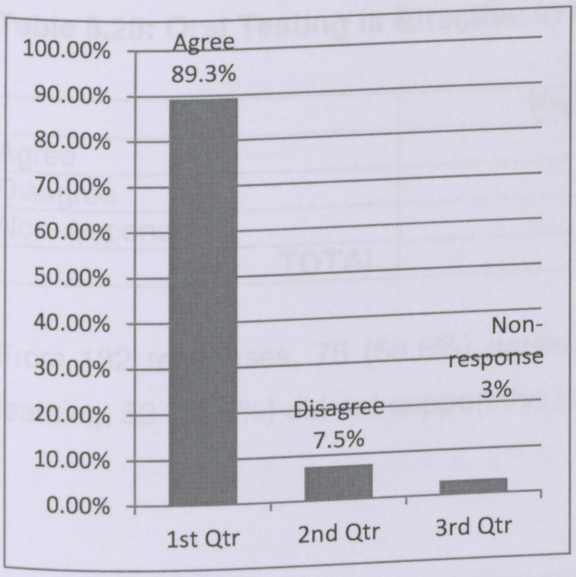


Figure 5.11: Group Discussion Reinforces Understanding of Mathematics

Agree	118 (89,3%)
Disagree	10 (7,5%)
Non-response	4 (3%)

One hundred and eighteen (89,3%) learners preferred group discussions to help them understand Mathematics. Ten (7,5%) disagreed with the statement, while four (3,0%) did not respond. The majority, thus, favoured discussions to help them understand Mathematics.

Table 5.19: Peer Teaching is Effective in Mathematics Learning

	Frequency	Percentage
Agree	108	81.8
Disagree	19	14.4
Non-response	5	3.8
TOTAL	132	100

Learners responses showed that 108 (81,8%) agreed with the statement, 19 (14,4%) did not agree with it and five (3,8%) did not respond. Most learners prefer peer teaching to understand Mathematics content.

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Table 5.20: Oral Testing is Effective in Mathematics Learning

	Frequency	Percentage
Agree	75	56.8
Disagree	52	39.9
Non-response	5	3.7
TOTAL	132	100

From 132 responses, 75 (56,8%) agreed that oral testing is effective in Mathematics learning, 52 (39,9%) did not support the statement, five (3,7%) did not respond.

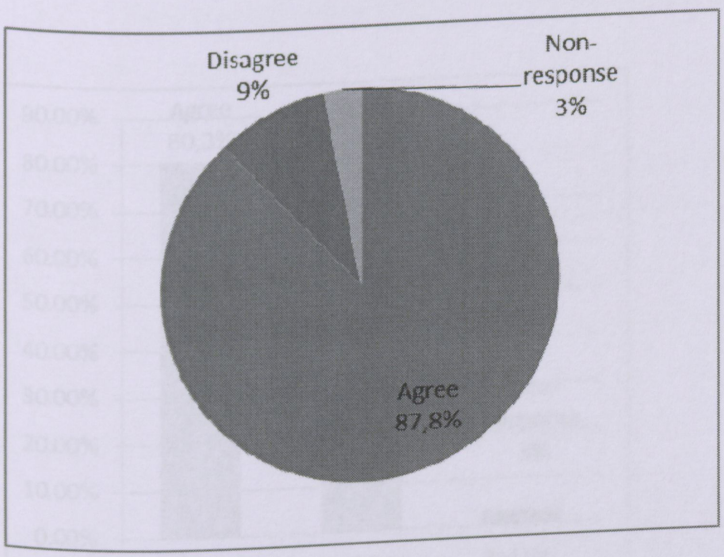


Figure 5.12: Active Engagement in Class Discussions Improves Mathematics Understanding

Agree	116 (87,8%)
Disagree	12 (9%)
Non-response	4 (3%)

One hundred and sixteen (87,8%) respondents agreed with the statement, 12 (9%) disagreed and four (3%) did not respond. Those supporting the statement are in the majority.

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Table 5.21: Posing of Questions for Clarity in Mathematics Class Enhances Understanding of Mathematics

	Frequency	Percentage
Agree	117	88.6
Disagree	12	9
Non-response	3	2.3
TOTAL	132	100

The results show that 117 (88,6%) participants agreed with the statement, 12 (9%) opposed it and three (2,3%) did not respond.

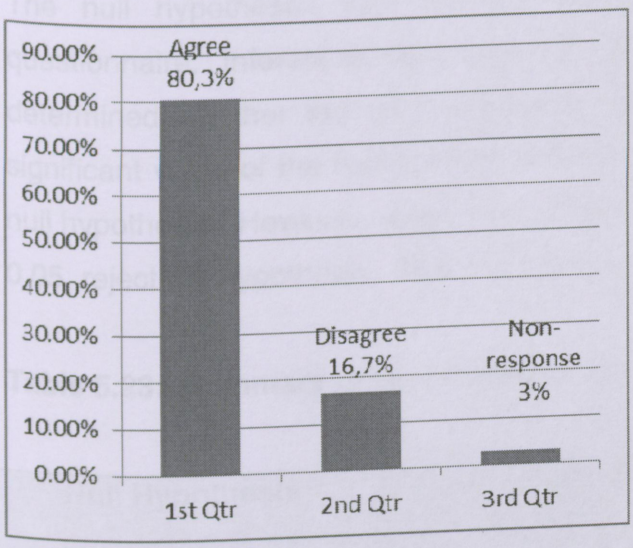


Figure 5.13: Teachers use English at Learner's Level of Understanding in Mathematics Class

Agree	109 (80,3%)
Disagree	22 (16,7%)
Non-response	4 (3%)

One hundred and nine (80,3%) were in favour of the statement, 22 (16,7%) were not in favour and four (3%) did not respond.

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Table 5.22: Extra-lessons Enhance Understanding of Mathematics

	Frequency	Percentage
Agree	119	90.1
Disagree	8	6.1
Non-response	5	3.8
TOTAL	132	100

In this statement, 119 (90,1%) agreed that extra-lessons enhance understanding of Mathematics. Only eight (6,1%) did not agree with it, and five (3,8%) did not respond.

5.3.2.3 Null hypotheses test of learners' questionnaire

The null hypotheses test was conducted to test the significance of learners' questionnaire. Inferences were drawn using the chi-square test. The significant value determined whether the null hypothesis should be retained or rejected. When the significant value of the test is more or equal to the value of 0,05 we do not reject the null hypothesis. However, when the significant value of the test is less than the value of 0,05 reject the hypothesis. The hypotheses test summary is presented as follows:

Table 5.23: Summary of Null Hypothesis

Null Hypothesis	Test	Significance value	Decision
The category defined by learners' challenges in Mathematics learning. =There are challenges and there are no challenges occur with probabilities 0.5 and 0.5	One sample Chi-square	.663	Retain the null hypothesis

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The hypothesis was: *High school learners who are taught Mathematics in English experience learning difficulties.*

The resultant null hypothesis is: *High school learners who are taught Mathematics in English experience no learning difficulties.*

The significance value of the test was 0.663, hence the null hypothesis was retained. This implies that learners who are taught Mathematics in English do not experience learning difficulties.

5.4 SUMMARY OF FINDINGS

This section covers the presentation of both qualitative and quantitative findings. Qualitative data were collected by interviewing curriculum advisers. Quantitative data were collected through questionnaires administered to Mathematics educators and learners.

5.4.1 Qualitative Findings

The qualitative findings shows that, the participants were highly experienced in the phenomenon as the respondents had all been serving as curriculum advisers for eleven years and more. Their experience, thus, confirms the credibility of the data.

Content data from the curriculum advisers were presented per research question. Research questions were addressed thematically. The question on how proficiency can be developed in the language of learning and teaching yielded five themes, all derived from the curriculum advisers' recommendations. Participants advocated for language teachers' support in the teaching of Mathematics, development of basic English communication skills, development of scientific terminology and relating English to Mathematical language.

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The second theme was based on the extent to which learners understand Mathematics textbooks. The findings show that most learners do not understand Mathematics textbooks on their own, hence they need support from teachers to grasp the subject matter. The third theme was base on how well secondary learners respond to questions which require interpretation. The findings show that learners lack language skills to respond to such questions and they underperform in that section. The fourth theme was on the contribution of home language proficiency towards mastery of Mathematics concepts. The findings revealed that the two languages do not influence each other.

The fifth theme focused on how Mathematics teachers address learners whose conceptual development in Mathematics is below the expected standard. Participants recommended diagnostic tests, extra classes and closing the content gap. Theme number six was on why Mathematics classes tend to attract very few students. This was attributed to learners' attitudes towards Mathematics, preference for Maths literacy instead of Mathematics and educators' influence.

5.4.2 Quantitative Findings

The quantitative findings were based on the educators and learners' responses in the questionnaires. The responses were presented in three categories, namely agree, disagree and not sure. The percentage of responses reflected the categories which were more popular and those which were not.

5.4.2.1 Educators' responses to questionnaire

Educators' responses to the questionnaire are summarised in the form of a Table as follows:

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Table 5.24: Educators' perception in the teaching and learning of Mathematics

No	Questionnaire statements	Agree	Disagree	Not Sure
13	Explanation of complex Mathematical concepts is Challenging	66.7	20.8	12.5
14	Learners are likely to participate in Mathematics discussions conducted in English	58'29	29.1	12.5
15	English language learners ask clarification questions in Mathematics class to clarify issues	66.6	25	8.3
16	Learners who use English as a language of learning and teaching, have a long listening span in Mathematics.	62.5	29.2	8.3
17	Most learners are proficient enough to understand Maths content in English	45.8	45.8	8.3
18	Learners who use English as a language of learning and teaching are likely to perform well in Mathematics	54.1	37.5	8.3
19	English language learners are likely to behave well in class	41.7	41.7	16.7
20	Learners who use English as a language of learning and teaching, participate during Mathematics lessons	62.5	29.2	8.3
21	The use of English as a language of learning and teaching, speeds up the teaching and learning pace	62.5	25	12.5
22	It is possible to focus on language and content development in Mathematics instruction	70.8	20.9	8.3
23	Code mixing between English and home language is effective in Mathematics teaching	70.8	20.9	8.3
24	Code switching between English and mother tongue promotes understanding of Mathematics content	75	16.7	8.3
25	Group discussion is an effective teaching approach in	91.7	-	8.3

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	Mathematics			
26	Learner-centred approach is effective in the teaching of Mathematics in English	83.3	4.2	12.5
27	Oral testing during Mathematics lessons promotes understanding of Mathematics	66.7	25	8.2
28	Learners are likely to understand Mathematical linguistic aspects	66.6	25	8.3
29	Extra-lessons improve learners' performances in Mathematics	87.5	4.2	8.3

The educators' responses show that they generally agreed with the statements. Responses to 15 statements were above 50% level in support. With regard to statements number 17 and 19, the responses were equal on agreement and disagreement rate at 45,8% with number seventeen and 41,7% with number nineteen.

5.4.2.2 Learners 'responses to the questionnaire

Learners' responses to the questionnaire are summarised in the form of a Table as follows:

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Table 5.25: The perceptions of learners in the learning of Mathematics

No	Questionnaire Responses	Agree	Disagree	Not Sure
8	I follow Mathematics presentations in English	81.9	15.2	2.9
9	I learn Mathematics through memorisation	46.2	49.2	4.6
10	I am proficient in interpersonal communication skills	63.6	25.7	10.6
11	I participate in group discussions conducted in English	52.2	43.1	4.5
12	I have a long concentration span in Mathematics	56.8	36.3	6.8
13	I communicate in English in Mathematics classes without fear of making mistakes	31.8	68.2	-
14	I prefer copying notes in Mathematics classes than responding to questions	62.8	33.3	3.8
15	The use of English and the mother tongue enhance my understanding of Mathematics	86.3	10.6	3
16	Group discussions promote understanding of Mathematics	89.3	7.5	3
17	Peer teaching is effective in Mathematics learning	81.8	14.4	3.8
18	Oral testing is effective in Mathematics learning	56.8	39.9	3.7
19	Active engagement in class discussions improves understanding of Mathematics	87.8	9	3
20	Asking questions in Mathematics classes enhances understanding of Mathematics	88.6	9	2.3
21	Teachers use English at learners' level of understanding	80.3	16.7	3
22	Extra-lessons enhance understanding of Mathematics	90.1	6.1	3.8

Learners' responses generally show that they agreed with the statements. Responses to thirteen statements were above the 50% level in support. However, responses on

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statement number eight and thirteen gave a different picture. 46,2% of learners agreed that they learn Mathematics through memorisation, whereas 49,2% disagreed and 4,6% were not sure. Responses to statement number thirteen reflected that 31,8 % of the learners were in agreement that they communicate in English in class without fear of making mistakes, whereas 68,2% had challenges.

5.5 DISCUSSION

This section consolidates quantitative and qualitative data as well as data from Literature. The responses of the curriculum advisers' and data from both educators and learners as well as literature were consolidated to respond to the research questions. The discussion shows similarities and differences in the responses of different participants. The responses from participants were counted and converted into percentages. The percentages of the responses were categorized as follows:

70% - 100% - high level priority
50% - 60% - moderate level priority
0% - 49% - low level priority

5.5.1 Challenges Encountered by Learners when Mathematics is Taught in English

Educators reflected moderate level priority in their responses with regard to question 15 and 16. They indicated that learners participate in classroom discussions, they ask questions and that oral testing helps them to understand Mathematics. A similar conclusion can be drawn from the learners' responses which were predominantly at moderate level. They assert that they participate in group discussions, communicate in English without fear, they prefer oral testing and also ask questions in class.

Literature revealed the challenges that learners encounter in Mathematics classes. For instance Ngidi (2007:18) claims that learners are self conscious and afraid of making mistakes and appear foolish when they try to express themselves in English. Sepeng

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(2010:163) asserts that it is difficult to persuade learners to speak in English during Mathematics lesson unless some coercive measures are applied to force them to participate.

The responses on question 17, 21 and 23 in the educators' questionnaire confirm that learners do not experience challenges when they are taught in English. Their responses are at moderate level confirming that learners have a long listening span, behave well in class and that learning in English is faster.

Educators' responses on question 18 on the proficiency of learners, reflected a low rating. This means that educators believe that learners are not proficient enough to learn in English. Learners' responses, however were at a high rating. They claim that they follow Mathematics lessons and that educators express themselves well, that is, at their level of understanding.

Fillmore (2007:337) reports that learners do not perform well in Mathematics because they experience challenges in understanding subject matter. Ngidi (2007:17), in his study conducted in Zululand, and found that secondary educators experience a communication breakdown during lessons. The challenge is attributed to learners' lack of proficiency in English as a language of learning and teaching.

Looking at the educators' and literature claims, one can conclude that learners have some challenges in following Mathematics lessons conducted in English. Because of that, they cannot perform well in the subject.

5.5.2 The Attitude and Perceptions of Educators on Teaching Mathematics in English

Educators' responses on question 24 reflect a high positive rating skewed on the ability of educators to develop English and content concurrently. The responses prove that educators hold positive attitudes towards the teaching of Mathematics in English.

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However, the curriculum advisers' responses on question 6 highlight that some educators encourage learners to change to Mathematics literacy which seems to be simple, implying that they do not have a positive attitude towards the subject.

Literature has shown that educators have a positive attitude towards the teaching of Mathematics in English. They prefer learners to access education, fulfilling jobs and books as presented. Literature, however shows that educators have negative perceptions to attending to content and development of language in Mathematics lessons. Most educators do not attend to linguistic development due to time constraints. Teachers only concentrate on covering the syllabus and the content (Uys, Van der Walt and Van den Berg, 2007:74).

Evidence from educators, curriculum advisers and literature reveal that, although educators have a positive attitude towards teaching Mathematics in English, they do not put it into practice as expected. Instead, educators have a tendency of code switching and mixing the home language and English to compensate for the lack of learners.

5.5.3 Proficiency of Learners in Responding to Examination Question Papers

The educators' responses to Question 20 reflect a moderate rating, meaning that learners perform well in Mathematics. Curriculum advisers, on the other hand, claim that learners do not perform well in Mathematics due to lack of proficiency in English. They further argue that learners develop a negative attitude towards Mathematics and, as a result, some decide to quit and do Mathematical literacy. Curriculum advisers however, argue that Mathematics is not that difficult since it is the only subject which learners are able to score 100 percent in.

Literature has revealed the unsatisfactory performance of South African learners in Mathematics exams. The poor performance of learners is revealed by their performance at Third International Mathematics and Science Studies.

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The responses from curriculum advisers and literature suffices for one to draw a conclusion that high school learners are generally not proficient enough to respond to Mathematics question papers written in English.

5.5.4 Success of Mathematics (as a subject) at Secondary School

Question 14 is rated moderate in the learners' responses and most educators claim that explaining complex concepts is not challenging. Question 29 was highly rated in favour of extra-lessons to improve learners' performance in Mathematics. The idea of extra-lessons was also popular among learners in their responses to question 22 in the learners' questionnaire. Fifty percent of the learners in their response to question 9 admitted that they learn Mathematics through memorisation. It is claimed that learners struggle in the learning of Mathematics. Most learners go through the grades with a poor background in Mathematics, lack of communication skills in class, code mixing and switching are meant to camouflage linguistic shortcomings.

Curriculum advisers, in question 6 also share the same sentiments that learners have a negative attitude towards Mathematics. They claim that learners have a tendency to change from Mathematics for Maths literacy. Due to a high failure rate, most learners develop a negative attitude towards Mathematics.

Since educators, learners, curriculum advisers and literature are in agreement that the learning of Mathematics is fraught with challenges, it is conclusive that learning Mathematics is not successful in South Africa due to the use of English as LOLT.

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CHAPTER 6

SUMMARY, LIMITATIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER STUDY

6.1 INTRODUCTION

This chapter presents the summary, limitations of the study, recommendations and suggestions for further studies. It also gives the conclusion and gives recommendations about future research.

6.2 SUMMARY

The summary outlines how the study addressed the research questions, the hypothesis, the literature review and the findings.

6.2.1 How the Study Responded to the Research Questions

Question 1: What challenges do learners encounter when Mathematics is taught in English?

Literature has made reference to many challenges which learners encounter in their learning of Mathematics taught in English as a medium of instruction (See subsection 2.2: Page 27). Curriculum advisers revealed that learners encounter many challenges in the learning and teaching of Mathematics. Learners' responses also revealed that Mathematics learners learn Mathematics through memorisation. Fifty percent of the educators indicated that most learners are not proficient enough to understand Mathematics in English. One can, therefore, conclude that the research responded to the question.

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Question 2: What attitudes and perceptions do educators hold towards teaching Mathematics in English?

Literature revealed that educators' attitudes and perceptions about teaching Mathematics in English are highly dependent on the value they associate it with. English is associated with access to education, fulfilling jobs, and social goods. However, most Mathematics books are written in English. It transpired that educators have positive attitudes and perceptions towards teaching Mathematics in English as second language.

Question 3: How proficient are secondary school learners in responding to Mathematics question papers?

Reviewed literature shows that the performance of learners at the Third International Mathematics Science Studies (TIMSS) was poor. The results revealed that South African learners underperformed in Mathematics due to lack of competence in English as a language of learning and teaching. Furthermore, curriculum advisers convey a general feeling that high school learners have difficulties in responding to interpretive questions.

Question 4: How successful is Mathematics (as a subject) at Secondary School?

Literature depicted teaching of Mathematics in English as a mammoth task in which learners experience some challenges in comprehending the content. Teaching of Mathematics in most cases is teacher-centred instead of being learner-centred as learners learn it through memorisation. Curriculum advisers argued that the teaching of Mathematics is a difficult task because learners do not like the subject due to lack of proficiency in English. However, both learners and educators' perspectives revealed that the teaching of Mathematics in English is successful.

6.2.2 How the Study Responded to Hypotheses

The Null hypotheses test was conducted using both educators and learners' questionnaires to test the significance of the instruments. The inferences were drawn

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using the chi-square test. The significance or P-value was determined for each questionnaire item. The significance value determined whether the null hypothesis was retained or rejected. The results of the tests were as follows:

6.2.2.1 Educators have positive attitudes and perceptions towards the teaching of Mathematics in English

The hypothesis was: *Educators have positive attitudes and perceptions towards the teaching of Mathematics in English.*

The resultant null hypothesis is: *Educators have negative attitudes and perceptions towards the teaching of Mathematics in English.*

The significance value of the test was 0.008, which is less than 0.05, hence the null hypothesis was rejected.

The rejection of the null hypothesis implies that, teachers have a negative attitude towards teaching Mathematics in English.

6.2.2.2 High school learners who are taught Mathematics in English, experience learning difficulties Mathematics in English

The hypothesis was: *High school learners who are taught Mathematics in English experience learning difficulties.*

The resultant null hypothesis is: *High school learners who are taught Mathematics in English do not experience learning difficulties.*

The significance value of the test was 0.663, hence the null hypothesis was retained. This implies that learners who are taught Mathematics in English do not experience learning difficulties.

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6.2.3 Summary of the Literature Review

The literature review revealed several issues around which the discussion of this study revolved. The study focused on the multi-dimensional theories that backed up the research. It discussed Cummins' theory of language proficiency which is constituted by Basic Interpersonal Communicative Skills. The threshold hypothesis and the comprehensible input theories were also discussed. All the theories were considered relevant since they proved how effective teaching can be when it is done simultaneously with the development of language skills in Mathematics.

There is a need to also consider the attitude and the perceptions of educators on the use of English as a language of learning and teaching. The attitude shows reasons why educators opt to teach in English instead of their mother tongue. The perceptions showed how educators feel about teaching Mathematics in English. This is important because learners' attitudes are likely to be influenced by their educators towards the language of learning and teaching. The current set up in South African schools on the use of English in the school system was compared with that of developed countries such as the United States of America, Canada and Ireland. The information enabled the researcher to compare the challenges encountered in South Africa and those encountered in developed countries. The researcher realized that, the international communities experience minimal linguistic challenges because they have special language programmes to cater for challenges encountered by English language learners.

It was necessary to also come up with the best practices that can be adopted in the effective teaching of Mathematics (See subsection 2.7 pages 59). The study also examined the teaching of Mathematics in English with special emphasis on the effects of the use of English as a language of learning and teaching (see subsection 3.2 pages 47-56). Literature review ended with suggestion on what methodologies could be used to teach Mathematics in a second language. The content and language integrated learning were considered. The method is relevant because it incorporates the teaching

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of Mathematics simultaneously with the development of language teaching (See subsection 3.3.1 pages 76).

Teaching of Mathematics in the zone of proximal development was also recommended. The zone of proximal development is the level that learners can reach if they are assisted by educators and peers. Furthermore, the second language approach to the teaching of Mathematics skills was outlined. The method recommends diagnostic or prescriptive systems to the teaching of Mathematics and it incorporates language development, in the teaching of Mathematics content.

6.2.4 Summary of Empirical Findings

Qualitative results revealed that learners encounter some challenges when English is used in the teaching of Mathematics. Quantitative data also revealed that learners encounter some challenges when they are taught Mathematics in English. Curriculum advisers also claim that teaching of learners in their second language is not successful. The following key findings were found:

6.2.4.1 Proficiency of learners in English as a language of learning and teaching in Mathematics

Collected data showed that learners' proficiency in English is below the expected level. Thus learners' experience some difficulties in the learning of the subject. Curriculum advisers indicated that learners lack basic English communication skills that are necessary in the learning of Mathematics. It also transpired that learners even struggle to answer interpretive questions due to lack of proficiency in English. This was supported by educators' who said that it is not easy to explain complex concepts in English to learners. Curriculum adviser number B indicated that:

Those questions that require interpretation are poorly answered mainly because of the language problem.

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Educators also claimed that learners are not proficient enough to understand Mathematics concepts.

6.2.4.2 Attitude of learners towards Mathematics

The findings of the research pointed out that learners have a negative attitude towards Mathematics generally. The point featured predominantly in the curriculum advisers' data. They claimed that learners' negative attitudes towards Mathematics are perpetuated by a high failure rate in the subject. The failure rate is attributed to lack of conceptual understanding in the lower grades. It is claimed that the pass requirement policy allows learners to go through the grades without passing Mathematics. Ultimately, most learners opt to do Mathematical Literacy because it is less challenging.

6.2.4.3 The best teaching practice in English

Curriculum advisers claim that, since second language learners experience some challenges in the learning of Mathematics, some strategies have to be found to solve. They argue that learners go through the grades failing Mathematics due to lack of language proficiency. The situation requires remedial and extra-tuition teaching to be conducted by educators outside the prescribed teaching time. It was suggested that educators should concentrate on closing the conceptual gap to enable learners to better understanding of content. It was recommended that teachers should start teaching with revision of the content covered in the previous grades for continuity. One curriculum adviser even suggested that, at the beginning of each year, diagnostic tests should be administered prior to teaching to identify learners' challenges.

Literature review has also revealed the best practices that can be applied to ensure effective teaching of Mathematics in English. The best practices covers simplifying and elaborating language, express Mathematical information in multiple ways, teaching Mathematics vocabulary, use of drawings and illustrations, elimination of linguistic complexities, access ELLs equitably with first language learners etc. Furthermore, the models for effective teaching of Mathematics were outlined which covers teaching

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Mathematics in the Zone of Proximal Development and application of Second Language Approach to Mathematics skills.

The researcher came up with the model for teaching Mathematics which considers the use of both English as second language and mother tongue. Content is imparted concurrently with language development,

6.2.4.4 Language teacher support

Curriculum advisers realised that, since there is need to equip learners fully with Mathematical language, English teachers should be involved in developing language skills. English teachers are expected to support Mathematics educators by giving learners some tasks which include Mathematical concepts. Curriculum adviser number D stated that:

> *"Ya, we expect the other teachers in the language to also assist us because the language teachers especially the English language teachers should also give them some tasks which uses especially scientific terminology. When they give some assignments or essay writing, so things like that should try to include topics that contain languages. I mean the scientific terminology that will assist understanding those concepts."*

6.3 LIMITATIONS OF THE STUDY

Creswell (1994:110) defines limitations of the study as the potential weakness inherent in every study. Similarly, Punch (2006:69) defines limitations of the study as the limiting conditions or restrictive weaknesses which are unavoidably present in the study's design. Vithal and Jansen (2010:35) assert that, acknowledging limitations of the study empowers the reader to appreciate what constraints were imposed on the study, and to understand the context in which the research claims are set. Therefore, there is a need for the researcher to outline the limitations inherent in this study.

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The study was designed to examine the influence of English as a language of learning and teaching in the Vhembe District. However, the research focused on Mvudi Circuit to conduct the study. The pilot study was undertaken at Sambandou Circuit. Mvudi is one of five circuits in the Thohoyandou cluster. Vhembe District is composed of five clusters. Due to time constraints, a small sample was used in the study. Therefore, the generalization of the outcome to a large population is not possible. One can therefore, speculate that research with a bigger sample might have yield different results.

To limit the scope of the study, the research focused on the influence of English on the performance of learners in Mathematics. The outcomes of the research might yield different results if the research had been conducted in other learning areas. Another limitation was the consultation time with the respondents. From time to time, the appointments had to be rescheduled due to unforeseen circumstances. The researcher had to be flexible to postpone the contact time and also meet with schools during vacation when educators were conducting extra-tuition.

The research period might also have impacted negatively on my research. The research concentrated on the data collected in the academic year 2015. If the study period had been longer, the results might have yielded different results.

The analysis of results revealed that some respondents skipped some questions which were left unattended. The responses were categorised as missing in the system. Had they been attended to, they could have altered the outcomes of the study.

Moreover, being part of the education system, with a vast experience in educational matters, could have resulted in biasness in the researcher's judgemental suppositions. However, since the researcher was aware of the potential influence, the researcher tried her best to be as subjective as possible and to let the situation unfold without interference.

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6.4 CONCLUSION

The researcher has realised that, the use of English as a language of learning can be effective if teaching is done simultaneously with the development of language of learning and teaching aspects. Mathematics teachers should also receive special training on the strategies to cope with teaching in English as a second language. Educators should adopt the best strategies recommended in this study to improve learners' understanding of content. Mathematics teachers should take learners through on how to respond to various questions. Mathematics educators need to be supported by curriculum advisers and school management teams to be successful in the teaching of Mathematics in a second language. Implementation of collaborative teaching of Mathematical language by language teachers can, hopefully, improve learners' performance in Mathematics.

6.5 RECOMMENDATIONS

The researcher recommends that teacher training education should reinforce teaching Mathematics in English as a second language. The program should be extended to continuous in-service training and workshops for educators. Implementation of teaching English across the curriculum should also be strengthened. This implies that teaching of Mathematics should be synchronised with the development of English proficiency to improve understanding of the subject matter. School management teams should also be orientated to ensure implementation of language across the curriculum. The practice is intended to improve learners' performance in Mathematics.

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The researcher designed a model titled, **Instructional Model of Mathematics teaching through English as a Language of Learning and Teaching as follows:**

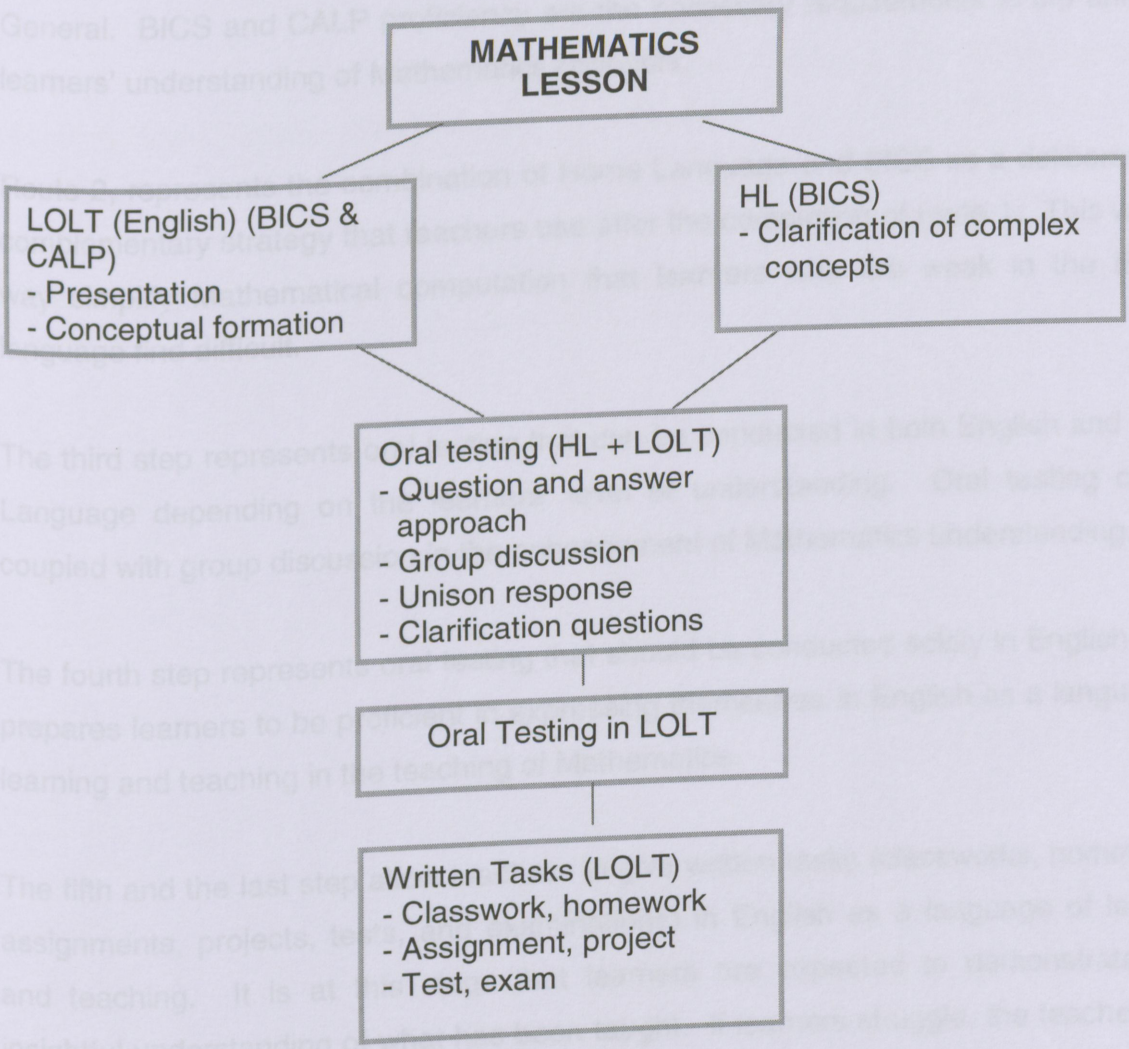


Figure 6.26: Instructional model of teaching Mathematics through English as a Language of Learning and Teaching.

Abbreviation Key

HL : Home Language

LOLT: Language of Learning and Teaching

BICS: Basic Interpersonal Communication Skills

CALP: Cognitive Academic Language Proficiency

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The model has two routes that have to be followed in the presentation of Mathematics Lessons. Route 1, represents Basic Interpersonal Communication Skills (BICS) and Cognitive Academic Language Proficiency (CALP) that are necessary for teaching in General. BICS and CALP proficiency are the necessary requirements in the unlocking learners' understanding of Mathematics concepts.

Route 2, represents the combination of Home Language and BICS as a deliberate and complementary strategy that teachers use after the completion of route 1. This will in a way simplify Mathematical computation that learners who are weak in the English language find difficult.

The third step represents oral testing that can be conducted in both English and Home Language depending on the learners' level of understanding. Oral testing can be coupled with group discussion in the enhancement of Mathematics understanding.

The fourth step represents oral testing that should be conducted solely in English. This prepares learners to be proficient in expressing themselves in English as a language of learning and teaching in the teaching of Mathematics.

The fifth and the last step allow teachers to give written tasks (classworks, homeworks, assignments, projects, tests, and examinations) in English as a language of learning and teaching. It is at this stage that learners are expected to demonstrate their insightful understanding of what has been taught. If learners struggle, the teachers can repeat the lesson at various steps.

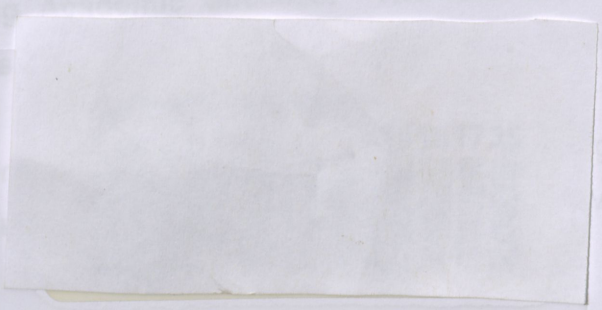
6.6 SUGGESTION FOR FURTHER STUDIES

The researcher realised that the influence of English as a language of learning and teaching has not been explored enough in South Africa. In this study, references are predominantly from other countries. Other countries such as the United States of America, Canada and Ireland are much advanced with research on the effect of the

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use of English as second language in Mathematics. The use of English as a foreign language in the teaching of learners and its impact on learners' performance is a global concern. Hence, there is a need to explore further on the topics related to this one.

In South Africa, the Department of Education is reinforcing the implementation of teaching English across the curriculum. Hence, there is a need to investigate how and to what extent teachers implement it at school level. Of equal importance is to conduct an investigation on the performance of learners in different subjects when they are taught in English as a language of learning and teaching..



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ANNEXURE A

TRANSCRIPTION OF CURRICULUM ADVISERS INTERVIEW

CURRICULUM ADVISER A

Question 1

I think hafhano, what is important ndi uri, the one who is teaching language khamusi ys tshikuwa, na ane a khou funza Mathematics vha funa uri vha shumisane because huna dzinwe dzi term, vha fanela uri vha shume vhothe. They should work together because there are certain terminologies dzine they are used in Mathematics but they are not used in English. So they do need to work hand in hand so that they can develop proficiency of language in the teaching and learning. Proficiency in important.

Question 2

On their own vha nga si understende. Its very difficult. That's the reason why vhana vha khou difeila even though they have textbooks. So what is important ndi uri vhana vha khou fanela u wana muthu a no vha assista how to read textbooks. The howness of it na uri a nga kona u I understandisisa hani uri arali vha nga sokou shuma vha fha nwana textbook vha ri kha vhale a ethe is very difficult uri a i pfesese. The language of Maths is difficult, it has to be taught.

Question 3

Hafha ndi hone hune vhana vha khou struggla hone ngauri vha fanela uri vha explaine especially vhana vha no khou bva ngeno kha dzi rural areas. Vha ya vha na thaidzo but hezwo a zwi ambi uri vhane vha khou bva kha urban areas Maths na language ine ya toda mudededzi uri a vha funze. So its very difficult uri ndi ambe ngazwo. Zwine vha vhona kha Gireidi 12 hu tshi da kha problem dzi no toda uri vha interprete Maths vha ya

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vha na thaidzo. They do not do well in those questions. They do not do well. Vha vha vha na thaidzo.

Question 4

Ya Tshivenda arali vhathu vho vha vha tshi khou funzwa Maths nga home language havha vhana they would do much better. Arali vha sedza fhethu vhana vha no nga vha vho-Japan-ngafhi vha vha vha tshi khou funzwa nga home language dzavho. Vha sedza havhala vhathu they do well, very well, far much better than us. Hovha hu tshi do vha na difference if English was home language. English ina thaidzo kha Maths. Generally muthu u guda nga luambo lwawe u fhirisa luambo lwa hayani. Hezwo zwa u mixer English na Tshivenda zwi ya creator problem a tshi do ya tertiary. Zwo vha zwi tshi do vha zwi right arali a tshi do ya a guda nga Tshivenda kana nga Tshitshangani uri arali a mixer hu do dovha ha creator problem khulwane. But zwonw zwi implaya uri nwana a konou pfesesa uri zwi kho tou tshimbilisa hani.

Question 5

Understand what they must do. Havha vhana must be given extra classes (remedial classes) vha funziwa nga pace ine vha kona u i pfesesa. Vha klasini vha do vha vha vha very fast.

Mara zwino arali vhanga vhona uri those learners are struggling we give them extra tutorials vha ri today we are going to deal with this, vha tou tuwa navho slowly. Then vhaya kona u addressa because in the class vha wana uri they have time factor within this period they should have covered those topics. Zwine vha nga recorda ndi uri vhana kha vha vhe na dzi extra classes dzine vhanga dzula vha funziwa.

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Question 6

Hezwi zwi khou tou bva kha uri Mafhungo eneo uri they have been told that Mathematics is very difficult, from the beginning, so I think arali ra nga thoma u bvisa hezwo zwithu zwauri Maths is not difficult, I think learners can do well. Zwino Gauteng i khou todou uri hu itiwe Maths fhedzi. Ari divhi uri zwino zwo no thoma naa?? MEC u khou uri hu vhulaiwe Maths Literacy. Ho vha ho funa hu na policy i no ri 80% i fanela u ita Maths, 20% i ite Maths Literacy. Zwo vha zwi tshi do vha zwi tshi khou thusa. Hu itiwe Maths fhedzi. We will see from them uti khavho zwi tou itisa hani. Zwino vha tshi tour i hu na Maths na Maths Literacy nwana u mbo di humbula uri Maths Literacy therefore I have to do Maths Literacy, ende that's not the case because when we check results learners get 300 in Maths. Maths Literacy ndi wone u no kondesa na dzidisti 30 they are not even hundred. Na kha Maths Literacy vha phasa kha zwenezwila zwauri Maths is difficult. Vhana vha fhedza vha tshi ri Maths is difficult naho hu tshi pfi vho phasa nga percent khulwane.

Zwino kha teachers we do not have enough teachers. Teachers encourage learners to do Maths Litereacy because they believe that Maths is difficult. In History zwi a konda u wana 300. Mathematics a u kondi. Vhathu vha tou vha na negative attitude khawo.

CURRICULUM ADVISER B

Question 1

It is better to develop the simple English language because Maths does not really need complicated language. Basic language skills in English is what is needed in Maths because they are required to simplify without using a calculator. Solve the following for x. That is very simple, complicated language is not necessary in Maths because in cases where we deal with modeling wherein we find word problem there are few cases where paragraphs can be used to describe certain Mathematical problems. Use a simple English.

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Question 2

Most of them think that to use a textbook is difficult. That is why sometimes or majority of them prefer notes given by the educator. Mostly they do not come with the books to school. Most of them have difficulty understanding or reading the textbooks. That is why they like notes given by the educator.

Question 3

Those that require interpretation are poorly answered mainly because of language problem. I think or maybe because the way educators are teaching them. I think another contributor may be that educators are not teaching them how to. It should start with teachers, and we cannot blame the learners. That is why even in the diagnostic report, the examiner tries to discourage educators using mostly old or previous question papers. Examiners try to say that educators should introduce learners to new type of questioning. Vha songo rely fhedzi kha dzi question papers dza kale ngauri dzinwe kha vha vha introduce na kha kuquesnele kiswa hune ku nga hunwe zwi include interpretation. That's why vha do wana kha statistics tshi nga da tshi tshi khou ri kha vha interprete it's poorly answered. Utshi pfa vha nga vha tshi khou tshipfa uri tshi khou nyaga calculator mara zwi no kha interprete zwi khou konda.

Question 4

A tshi tou contributhesa ngauri mostly hu funziwa ngatsho. A tshi tou contributhesa. Is not that much ngauri hunzhi a hu funziwi ngatsho ndi sa divhi vho kha dzi grade dza fhasi mara mostly kha FET they do not use home language.

Question 5

Zwine vha ita ndi zwezwi zwa u tou traya u arranger extra lessons navho to try to teach in the afternoon or in the morning before school starts and na nga dziholodei ndi hafho

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hune vha khou traya u ketshapa zwa murahu. Na rine ri vha ri khou vha encourager zwezwo zwauri extra-lessons dzi songo vha dzi khou tou toda u covera syllabus. Kha dzi vhe dzi khou sedzesa uri backlog because there is a big problem kha Maths ndi yeneyo. Foundation kha Maths i vha i si grand.

Question 6

They have negative attitude towards Maths because even the educators sometimes tell the learners that Maths is for the few that is why we discourage educators too. They must try to build a positive attitude towards Mathematics so attitude heila yauri Maths is difficult ya bva then ri nga vha right badi. That's why na nne ndi tshi u funza. I try to develop a positive attitude nda ndi tshi ita zwa uri Maths is not difficult u tou kombodza. Ndi khou humbula kha tshinwe tshikolo last week ro do ri ro ya the educator concerned ari kha ri addresse vhana, ra ri vhavhili, vhanwe vha addressa vha amba zwine vha khou amba havha huna mbalo kha bodo ndari ni khou zwi vhona zwa uri no khou nwala i tshi khou tsela fhi? Ndi tshi khou amba zwezwo uri ha u tou kombodza a u kondi, ndi tshi nwala so nda mbo di khakha ngauri ndo vha ndo no kombodzala ngauri nthani ha plus ndi nga khakha nda ri minus.

CURRICULUM ADVISER C

Question 1

Thank you ma'am, the way in which learners can be assisted in the language of learning and teaching Maths is for maybe the educators to assist maybe translating from Maths to English and vice versa. Why? Because you will find that learners understand the language of English but fail to relate it to Maths. They need to translate when they answer from English to symbolic notation. It's really quite different. It's not basically the same. When a person is saying greater than but in Maths we use a symbol for that. When you say equal to in English we say equal to but in Maths we have a symbol for that. In Maths when we use an *n*, it stands for a number when we

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say *a + b* learners do not understand. Even the teachers when they say A + B , it's better to say the sum of A and B. You say it in English but write Maths so that learners get used to notations.

Question 2

Usually the textbooks that are coming now are much easier to understand for learners because the approach that is used by authors these days is like the book is talking to a learner whereas in the past most of the things used to be synthetic. It means the teacher had to turn it around and analyse and present an analytic push of the whole thing. You find a book actually talking to a learner. They are adopting books to language which is spoken. Unlike books that were just giving examples and exercises. These days the books that are coming, you find are talking to learners. Sometimes it will say in a pair, discuss these, this or in a group discuss this or report this. Books nowadays it's like they are talking to learners.

Question 3

Generally that's where there is a problem because learners are reluctant to express their own opinion, their own views. If you say what do you understand by this, they find it difficult even if you say between this and this which do you think is the better option?. They have to explain. They have to choose an option but when they come to explaining there is a problem. They do not perform well even if they have to answer by yes or no and end there without explaining. Explanation is a problem. Even in Mathematics there are graphical presentations learners have to explain to be able to say if this variable increase or decrease what happens to the other one?

Question 4

Not really. It does not contribute because usually learners who do Mathematics especially in the FET understand the language. They have no problem even if you

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teach them in Tshivenda or English usually it does not even change the situation because basically you will see when marking of Maths papers is done, they do not say Afrikaans papers should be marked by Afrikaners. It is the same. The language is only where there are sentences where maybe a marker is not clear with some words, they can seek clarity but the rest are like that. It is not necessary to switch to Tshivenda because there are no words in Tshivenda to explain Mathematics.

Question 5

What is happening with some of the teachers is that you will see a learner, let's take for example a learner is coming from grade 9 and this learner will then choose Mathematics in grade 10. The learner will pass other subjects and go on to Grade 11 without passing Mathematics. What is advisable is that when you teach them you start from grade 10 work. Even in grade 12 we advise educators to do the same grade 11 work. Some concepts are easier that way, if you start from grade 10 you can still build up the concepts. Even if learners passed it, it's advisable to start from grade 10 and 11 work. It's making work difficult. This is basically what is being done. These learners do not pass lower grades. Grade 12 educators are doing a big job. Thus how we are managing to improve the situation. They start from grade 10, 11 and then grade 12. These learners do not pass Maths well in grade 9.

Question 6

The traditional way of looking at Maths, Maths is looked at as a difficult subject and yes it becomes difficult when the foundation is not there. Obviously another thing is that now there is an option that if a learner is not doing well in Maths that learners can switch on to Maths Literacy. Some learners are doing that in grade 11 and some are even changing from Maths to Maths Literacy in grade 12, because grade 12 are allowed to change one subject. Usually that subject is Maths to Maths Literacy. What is interesting with this shift from Maths to Maths Literacy is that learners pass

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Mathematics. In Maths they learn how to work with numbers and this is enough to pass Maths Literacy. This is what learners are doing.

CURRICULUM ADVISER D

Question 1

Ya, we expect the other teachers in the language to also assist us because the language teachers especially the English language teachers should also give them some tasks which uses especially scientific terminologies when they give some assignments or essay writing so things like that should try to include topics that contain languages. I mean the scientific terminology that will assist understanding those concepts.

Question 2

Ya, it is not that very good in the sense that because some of the terminology and the language is difficult for learners. They have to read again and again to understand the meaning and then the concept that is a different thing but simple meaning to understand is also difficult. If it is in the mother tongue they may catch up immediately but it will take them some time to understand it. Ya, it is difficult, you will see that.

Question 3

Maths is poor in the sense that is why you can see that learners offering Maths Literacy are failing or they are scoring low marks not because they don't understand that Mathematical concept but because in Mathematical concepts there is low level Maths Literacy to understand them but language is playing important role in Maths Literacy compared to Maths. Maths Literacy uses lots of language and what we generally see is that the understanding there is poorer. That is a major challenge for those learners doing Maths Literacy. They thought Maths Literacy is better but in terms of

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Mathematical concepts is of low level. The language explanation and interpretation, things like that is finding difficult in Maths Literacy. In Maths Literacy they do not see that Maths problem. In terms of language because interpretation is less therein the reading understanding the language less. It is more Mathematical terminology and things like that. The language is used more in Maths Literacy than in the other Maths. So how they understand that is a problem. Because we do not use so much moments context situation in pure Mathematics than in Maths Literacy they use lots of scenarios in the Maths Literacy. So to understand that they should be good in the language. That is a challenge they find.

Question 4

It is affected only to a certain level in the sense, the first level understanding and interpretation but the mathematical concept is little more than this language issue. Mathematical skills they should have. So understanding the meaning is to one level then to Mathematical skills is to another level. So if we have to master the language issues understanding it is not necessary to master Mathematics. So that needs even more technical or not that technical Mathematical understanding in that if a learner is good in language does not give a chance to be good in Mathematics. Mathematics should have its own Mathematical skills. To a certain level just the primary level to understand meaning and the interpretation of that. But then the second level is Mathematics skills.

Question 5

Ya, again as they see that one is not understanding the question because of the language issue is complicated. But after understanding the language again they should see the Mathematical concepts, know the Mathematical skills and we have a problem that the teachers find these learners are not doing well. But the reason is that the basics of these things are not strong enough to have that higher level Mathematics, so they should go to the basics and start with the basics even if you are teaching grade 10

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you have to go to grade 8 or even lower level to see that basic things then from there they should develop.

The best thing is to give the diagnostic test and see what is the problem. From there you try to give the foundation on that and then you can develop on that. That is the way they should be doing because for a teacher they have been given a pace setter program on how to beat the time and how to follow the program. They say there is no time to go back because the limited time is given so between that time they are not able to cover that pace. So they say there is not time to go to the foundation and that is a problem. This time recitation is a problem looking at the levels and the teacher should be prepared to sacrifice extra time and resources. You cannot use the same medicine for everybody. You ought to prepare your learners and teach them according to their level of understanding.

Question 6

One reason I mean is poor understanding of the basics because in the lower level they are not given that Mathematical skills. I mean the basic concepts. That basic understanding when you go to higher level. The poor understanding of the basics is one reason. And another problem is everybody's general concept that Maths and Science is a very difficult subject. That is the understanding people have but it is not always the case that it how it should be. Maths is they understand and if the basics are good learners can do well. So it is a general rumor and fear that Maths is difficult. It is a general opinion but if looking at a subject especially for our region Vhembe or even, ya around Limpopo it is not a big issue for us compared to other provinces. Because of the policies that our leaders are established and because if you look at the number of learners doing Mathematics in Grade 12 or science and Maths you have a large number of learners compared to even other provinces. Our reason for that is that in the olden days in some schools it was rules that everybody must do Mathematics whereas they were not given option. So they were forced to do Maths in all schools whereas in other areas it was a choice subject so our school enrolment in Maths and Science is really

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very good. And even the girls if you look at the girls number some of our school are more girls than the boys. That is mainly in the role we find in this area unlike in other areas. In other areas there are more boys and even they are promoting and having lot of programs attracting girl learners to Maths and Science. They are running a lot of programs for that. Whereas we already have more girls in our schools.

LIBRARY

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APPENDIX B

PERMISSION LETTER FROM DISTRICT SENIOR MANAGER

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

VHEMBE DISTRICT

REF: 14/7/R
ENQ: J MAGUGUMELA

MAKHUVHA L.C
P.O.Box 759
Thohoyandou
0950

DEPARTMENT OF EDUCATION
VHEMBE DISTRICT
2015 -04- 09
PRIVATE BAG X2250 SIBASA 0970
LIMPOPO PROVINCE

PERMISSION TO CONDUCT RESEARCH IN VHEMBE DISTRICT

1. The above matter bears reference
2. Your request for permission to conduct research for doctorate degree on the topic "the influence of English as a language of learning and teaching on high school learners' academic performance in Mathematics in Thohoyandou cluster has been granted.
3. You are kindly requested to observe the following conditions:
3.1. Inform the Circuit Managers and Principals of affected schools prior to your visits to conduct your research.
3.2. Ensure that your interactions with schools do not interrupt teaching and learning activities.
4. Wishing you the best in your quest for intellectual achievements.

.....
DISTRICT SENIOR MANAGER

09.04.2015
DATE

Thohoyandou Government Building, Old Parliament, Block D, Private Bag X2250, SIBASA, 0970
Tel: (015) 962 1313 or (015) 962 1331. Fax: (015) 962 6030 or (015) 962 2288

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APPENDIX C

INFORMATION PERTAINING TO THE IMPLEMENTATION OF RESEARCH PROCEDURE OF COMPLETING INTERVIEW AND QUESTIONNAIRE

School of Education
Department of Professional Studies
Private Bag X5050
Thohoyandou
0950
Email: livhu46@hotmail.co.za;
Work: 015 962 4526;
Mobile: 072 283 6076;

My name is Makhuvha L.C, a doctorate student in the Department of Education at the University of Venda. I am conducting research under the supervision of Dr M.P Mulaudzi. I am conducting my studies on the influence of English as a language in the learning and teaching of Mathematics and its influence on academic performance of Grade 12s in Mathematics in the Vhembe District. The study will furnish the educators, curriculum advisers, education planners, parents, learners and researchers with information on how English as a language of learning influences the Mathematics performance of Grade 12s.

Completion of the questionnaire will take about 15 minutes of your time. Participation in this project is completely voluntary, hence your participation will be highly appreciated for it will contribute to the completion of the research project.

The completed questionnaires will be personally collected from school principals on the same day they will be administered.

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If you have any questions about this study please feel free to contact the researcher at (015) 962 4526 or 072 283 6076 or e-mail at livhu46@hotmail.co.za.

The researcher would also like to assure you that the study observes ethics of research. The information collected in this study will be used for the purpose of this study only.

Yours in service

_____

MAKHUVHA L.C (MRS)

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APPENDIX D

CURRICULUM ADVISER: CONSENT FORM

Consent form to conduct research in the school

I, ... consent to complete the questionnaire designed by Livhuwani Cathrine Makhuvha for her study on: **The Influence of English as a language of learning and teaching on the performance of learners in Mathematics in the Vhembe District.** I understand that:

-Participation is voluntary

-That as a school we may withdraw at any time

-No information wich identify the school and individuals will be included in the report and the response will remain confidential.

Signature: .....

Date: .....

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APPENDIX E

EDUCATORS: CONSENT FORM

Consent form for interviews and questionnaires

I, ... consent to complete the questionnaire designed by Livhuwani Cathrine Makhuvha for her study on: **The Influence of English as a language of learning and teaching on the performance of learners in Mathematics in the Vhembe District.** I understand that:

-Participation is voluntary

-That as a school we may withdraw at any time

-No information which identify the school and individuals will be included in the report and the response will remain confidential.

Signature: .....

Date: .....

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APPENDIX F

LEARNERS: CONSENT FORM

I, ... consent to complete the questionnaire designed by Livhuwani Cathrine Makhuvha for her study on: **The Influence of English as a language of learning and teaching on the performance of learners in Mathematics in the Vhembe District.** I understand that:

-Participation is voluntary

-That as a school we may withdraw at any time

-No information which identify the school and individuals will be included in the report and the response will remain confidential.

Signature: .....

Date: .....

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APPENDIX G (IN TSHIVENDA)

THENDELO NGA MUBEBI

Nne mubebi/muunḓi wa ....., ndi khou tenda uri ṅwana wanga a dzhenele kha ṱhoḓuluso ya "Ṱhuṱhuwedzo ya vhukoni ha mbalo nga luambo lwa tshikhuwa lu tshi shumiswa u funza vhana".

Ndi khou tenda u ri ṅwananga a fhindule mbudziso dzi elanaho na iyo ṱhoḓuluso. Nahone ndi khou pfesesa uri:

- U dzhenelela a si khombe-khombe.
- Ṅwananga o vhofholowa u litsha arali a si tsha funa.
- Ṱhoḓuluso iyo i do shumiswa fhedzi kha yeneyi ngudo fhedzi.

Madzina a mubebi/muunḓi .....

Tsaino: ..... Datumu: .....

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APPENDIX G (IN ENGLISH)

PARENTS: CONSENT FORM

I, ... consent to my child taking part in **"The influence of English as a language of learning and teaching on the performance of learners on Mathematics in the high school in the Vhembe District"** at _____ under the supervision of Dr M.P Mulaudzi from the University of Venda.

I consent to the questionnaires, my academic marks and other test results the school might have use for the purpose of the study.

I understand that:

-participation in this research is voluntary

-I may withdraw from the study at any time during the course of the study

-no information will identify the individual or the school, and all responses will remain confidential.

Name of learner: .....

Signature: ..... Date: .....

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APPENDIX H

INTERVIEW SCHEDULE FOR CURRICULUM ADVISERS

RESEARCH TOPIC: The Influence of English Language of Learning and Teaching on Grade 12 academic performance in Mathematics in the Vhembe District

Time of Interview:
Date:
Place:
Interview:
Interviewer: **Makhuvha L.C**

The purpose of the study is to determine the influence that English as a language of learning and teaching has on Grade 12 learners performance in Mathematics in the Vhembe District.

The data will be collected from Mathematics educators, learners, curriculum advisers and examination reports. The data will only be used for the purpose of the study only and it will be kept confidential. The interview will take approximately 20 minutes.

The interviewee will be requested to sign the consent form prior to the interview.

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APPENDIX I

QUESTIONNAIRE FOR EDUCATORS

SECTION A: BIOGRAPHICAL INFORMATION

This section requires educators' biographical information. Responses will be used for statistical purposes only. Confidentiality is guaranteed. Please indicate with an "x" in the appropriate space that which most closely represents your personal situation. Please mark one item only per question.

1.Gender

		For Office Use Only	
Male	1	A1	
Female	2		

2. Age (in years)

20 – 29	1	A2	
30 – 39	2		
40 – 49	3		
50+	4		

3. Current Position You Hold

CS1 Educator	1	A3	
HOD	2		
Deputy Principal	3		
Principal	4		

4. Highest Academic Qualification

Diploma	1	A4	
Degree	2		
Honours	3		

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Masters	4		
PHD	5		

5. Highest Qualification in Mathematics

In-service training certificate in Mathematics	1	A5	
Diploma + Mathematics	2		
Degree + Mathematics	3		
Honours + Mathematics	4		
Masters + Mathematics	5		
Doctorate + Mathematics	6		

6. Your Mother Tongue is

Venda	1	Ndebele	7	A6	
Tsonga	2	Tswana	8		
South Sotho	3	Swazi	9		
Northern Sotho	4	English	10		
Xhosa	5	Afrikaans	11		
Zulu	6	Other	12		

7. Apart from mother tongue, in which of the following language(s) are you able to conduct a sustainable conversation?

Venda	1	Ndebele	7	A7	
Tsonga	2	Tswana	8		
South Sotho	3	Swazi	9		
Northern Sotho	4	English	10		
Xhosa	5	Afrikaans	11		
Zulu	6	Other	12		

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8. Your years of experience in teaching Grade 12 Mathematics

1 – 5	1	A8	
6 – 10	2		
11 – 20	3		
21+	4		

9. Have you undergone professional training to teach in the Second Language?

No	1	A9	
Yes	2		

10. When last did you attend Mathematics in-service training?

Never	1	A10	
6 months back	2		
1 – 2 years back	3		
3 – 4 years back	4		
5 years +	5		

11. How often are you supported by Curriculum Advisers in Mathematics teaching?

Never	1	A11	
Regularly	2		
Monthly	3		
Quarterly	4		
Twice per year	5		

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12. How often do you attend Mathematics workshops per year?

Never	1		
Once	2	A12	
Twice	3		
Thrice	4		
Four times	5		
Five times +	6		

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SECTION B: EDUCATORS CHALLENGES IN MATHEMATICS TEACHING

The questions in this section sought to reveal the challenges that educators associate with Mathematics teaching and learning. Please indicate with an "x" in the appropriate space representing your situation. Please mark one item per statement according to the following five point scale:

1 = Strongly Disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly Agree

Educators' Challenges in Mathematics Teaching	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	For Office Use Only
13. Explanation of complex Mathematical concepts is Challenging	1	2	3	4	5	B1
14. Learners are likely to participate in a Mathematics discussion conducted in English	1	2	3	4	5	B2
15. English language learners ask clarification questions in Mathematics classes	1	2	3	4	5	B3
16. Learners who use English as a language of learning and teaching, have long listening spans in Mathematics.	1	2	3	4	5	B4
17. Most learners are proficient enough to understand Maths content in English	1	2	3	4	5	B5
18. Learners who use English as a language of learning and teaching are likely to perform well in Mathematics	1	2	3	4	5	B6

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19. English language learners are likely to behave well in class	1	2	3	4	5	B7
20. Learners who use English as a language of learning and teaching, participate during Mathematics lessons	1	2	3	4	5	B8
21. The use of English as a language of learning and teaching speeds up teaching and learning of Mathematics.	1	2	3	4	5	B9
22.It is possible to focus on language and content development in Mathematics instruction	1	2	3	4	5	B10
23. Code mixing between English and home language is effective in Mathematics teaching	1	2	3	4	5	B11
24. Code switching between English and mother Tongue enforces content understanding in Mathematics	1	2	3	4	5	B12
25. Group discussion is an effective teaching approach in Mathematics	1	2	3	4	5	B13
26. The learner centred approach is effective in the teaching of Mathematics in English	1	2	3	4	5	B14
27. Oral testing during Mathematics lessons enforces understanding of Mathematics	1	2	3	4	5	B15
28. Learners are likely to understand Mathematical linguistic aspects	1	2	3	4	5	B16
29. Extra lessons improve learners' performance in Mathematics	1	2	3	4	5	B17

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APPENDIX J

QUESTIONNAIRE FOR LEARNERS

SECTION A: BIOGRAPHICAL INFORMATION

With the following questions, biographical information is sought. Your responses will be used for statistical purposes only. Confidentiality is guaranteed. Please indicate with an "x" in the appropriate space that which most closely represents your personal situation. Please mark one item only per question.

1. Gender

			For Office Use Only
Male	1	A1	
Female	2		

2. Age (in years)

16 – 17	1	A2	
18+	2		

3. Field of Study

Sciences	1	A3	
Commerce	2		
General	3		
Other, specify	4		

4. Mathematics Performance in the last Quarter (in percentage)

0 – 29	1	A4	
30 – 39	2		
40 – 49	3		
50 – 59	4		
60 – 69	5		

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70 – 79	6		
80 – 100	7		

5. What is your target Mathematics pass percentage in the end of the year examination?

0 – 29	1	A5	
30 – 39	2		
40 – 49	3		
50 – 59	4		
60 – 69	5		
70 – 79	6		
80 – 100	7		

6. Your Mother Tongue is

Venda	1	Ndebele	7	A6	
Tsonga	2	Tswana	8		
South Sotho	3	Swazi	9		
Northern Sotho	4	English	10		
Xhosa	5	Afrikaans	11		
Zulu	6	Other	12		

7. Apart from your mother tongue, in which of the following language(s) are you able to conduct a sustainable conversation? You can choose more than one if applicable.

Venda	1	Ndebele	7	A7	
Tsonga	2	Tswana	8		
South Sotho	3	Swazi	9		
Northern Sotho	4	English	10		
Xhosa	5	Afrikaans	11		
Zulu	6	Other	12		

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SECTION B: CONTENT KNOWLEDGE

The questions in this section sought to reveal the challenges that learners associate with Mathematics, challenges that make them not to have interest in the subject. Please indicate with an "x" in the appropriate space representing your situation. Please mark one item per statement according to the following five point scale:

1 = Strongly disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly agree

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	For Office Use Only	
8. I follow Mathematics presentations in English	1	2	3	4	5	B1	
9. I learn Mathematics through memorization	1	2	3	4	5	B2	
10. I am proficient in interpersonal communication skills	1	2	3	4	5	B3	
11. I participate in group discussions conducted in English	1	2	3	4	5	B4	
12. I have a long concentration span in Mathematics	1	2	3	4	5	B5	
13. I communicate in English in Mathematics class without fear of making mistakes	1	2	3	4	5	B6	
14. I prefer copying notes in the Mathematics class than responding to questions	1	2	3	4	5	B7	
15. The use of English and mother tongue enhances understanding of Mathematics	1	2	3	4	5	B8	
16. Group discussions enforcing understanding of	1	2	3	4	5	B7	

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Mathematics							
17. Peer teaching is effective in Mathematics learning	1	2	3	4	5	B6	
18. Oral testing is effective in Mathematics learning	1	2	3	4	5	B5	
19. Active engagement in class discussions improves understanding in Mathematics	1	2	3	4	5	B4	
20. Asking of clarification questions in Mathematics classes enhances understanding of Mathematics	1	2	3	4	5	B3	
21. Teachers use English at learners' level of understanding	1	2	3	4	5	B2	
22. Extra lessons enhance understanding of Mathematics	1	2	3	4	5	B1	

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