

**An exploration of the teaching and learning of mathematics  
word problems in English to second language grade 8  
learners in the Mafukuzela-Gandhi Circuit**

**Submitted in fulfillment of the requirements of the degree of Master of  
Technology: Language Practice in the Faculty of Arts and Design at the  
Durban University of Technology**

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**MTech: Language Practice**

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**PhD (Education)**

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**by**

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Durban University of Technology**

**I, Annaleah Pooran, do declare that this dissertation is a representation  
of my own work in both conception and execution.**

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## ABSTRACT

The abolition of apartheid in South Africa in the late 1980s and the advent of democracy in 1994 resulted in dramatic changes in the education system. Of great significance to this study is the freedom African parents were allowed in choosing the medium of instruction to be used at schools. Surprisingly African parents encouraged their children to study through the medium of English mainly due to the education and employment opportunities English will provide them in the future (Mda, 1997).

Now, seventeen years into democracy, English as a national language and the preferred medium of instruction has been blamed for poor results among ESL learners (Moreosole, 1998). Taylor, Muller and Vinjevold (2003: 54) point out that the difficulties associated with studying in a language other than one's home language are more pronounced in mathematics, a subject which is strongly dependent on technical language proficiency. A section in the Grade 8 mathematics syllabus that is generally problematic for ESL learners is that of word problems (Wetzel, 2008). This is because ESL learners lack the language and reading skills needed to comprehend word problems, and the listening skills required to understand the educator's explanation of the solution (Crandall, Dale, Rhodes and Spanos, 1985).

To address the aims and objectives of this study, relevant literature was reviewed and various teaching strategies were examined to determine which strategies may be most effective in helping ESL learners solve word problems. Grounded within the Constructivist Learning Theory, this study was based on Vygotsky's zone of proximal development and Bruner's concept of scaffolding. Using a mixed methods approach, this study investigated problems that mathematics educators and ESL learners experience in the teaching and learning of word problems through the medium of English, and also identified strategies that mathematics educators use to teach word problems to ESL learners.

Analysis of the educator questionnaire and the focus group interviews with learners revealed that ESL learners are experiencing difficulty solving word problems in English and educators are, to a large extent, adapting their teaching strategies when teaching them. The data also indicated that groupwork was considered by the majority of educators to be the most suitable method in the teaching of word problems to ESL learners, but sadly this method was used less frequently compared to whole class discussion and individual work due to discipline problems, the educators' inability to handle group dynamics and the tendency for learners not to contribute to the group discussion. The findings also suggest that it is necessary for the educator to use a variety of teaching strategies to ensure that ESL learners enjoy success in mathematics.

Based on the findings, this study makes recommendations regarding the teaching and learning of word problems and the use of adapted teaching strategies to foster active participation in lessons and group discussions, thereby increasing learner confidence and aiding in the understanding of English terminology used in mathematics word problems.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 BACKGROUND TO THE STUDY

Education is the most powerful weapon which you can use to change the world (Nelson Mandela, in Edge, 2010: 48).

Education was used as a weapon in South African education during the apartheid era to the advantage of Whites and to oppress Black people (Sonneborn, 2010: 30). Apartheid in South Africa ensured that it was difficult for “native children” to benefit from education and progress in life (Verwoerd, 1953: 3585) since they were seen to be inferior to White people (Mandela, 1990). So strong was the effect of this weapon, that even after the abolition of apartheid, its consequences continue to plague South African schools (Kelley, 2008: 23).

Pre-1994, the South African education system was an authoritarian and state-controlled system (Jansen, 2001: 42) that was administered according to racial lines and by various central government departments (De Wet, 2011). The policies of Bantu Education led to a highly controlled type of education, especially in the area of language. According to Akhurst (2008: 365), African learners received instruction in their home language during the first four years of schooling thereafter the medium of instruction was abruptly changed to Afrikaans or English. He adds that the change in medium of instruction led to great difficulties, mainly because African learners had very little contact with the language they were being forced to learn. Taylor, Muller and Vinjevold (2003: 54) explain it is highly probable that the difficulties associated with studying in a language other than one’s home language are more pronounced in subjects like mathematics and science, which are strongly dependent on technical language proficiency and prior proficiency in the language of instruction.



Gutstein (2009: 138) said that mathematics education can be used as a weapon in the struggle for social justice. Indeed policymakers all around the world are calling for mathematics education to better prepare learners for the workplace and life in a complex and technologically charged society (Hamilton, 2007: 4-5). Hamilton (2007: 5) expresses concern that classroom practice is resistant to change even though mathematics classrooms have been changing so rapidly. A rapid change has taken place in the demographics of English-medium schools in South Africa where large numbers of formerly disadvantaged learners are now attending the better resourced English-medium schools. These learners face a significant hurdle when they enter formal schooling especially when the language of instruction is not spoken at home (World Bank, 2010: 174). One would have assumed that the introduction of democracy in South Africa would have meant equal rights in school for all, but the euphoria of 1994 settled to reveal no change in the medium of instruction at schools.

## **1.2 CONTEXT OF THE RESEARCH**

Post-1994, English remains the dominant language of communication in South Africa. According to the South African Schools Act, Act 84 of 1996, section 6, paragraph 2, learners have a right to receive educational instruction in the official language or languages of their choice, where practical. The objective of this act is to provide for the protection and advancement of the country's diverse cultures and languages. Sadly, the education sector does not totally reflect the multilingual nature of South Africa (Olivier, 2006). Our classrooms are made up of learners and educators that are very diverse in terms of culture, language, race and background (Singh, 2010). Research in South Africa has shown that English second language (ESL) learners perform poorly in subjects like mathematics, science, and other content subjects due to the language barrier (Singh, 2004; Mangena, 2002).

### **1.2.1 Multilingual and Multicultural Classrooms**

Many originally Indian and Coloured schools now have predominantly African learner enrolments, especially if they are close to African townships or the city centre. The changing racial and socio-economic status of learner enrolments in former White, Indian and Coloured schools has raised concerns about the capacity of schools to cope with multicultural and multilingual classes (Hofmeyr, 2000). A multicultural classroom is one that consists of learners from different cultural and racial backgrounds (Banks, 2001) while multilingual classrooms are made up of learners with different home languages (Broeder, Extra and Maartens, 2002). Whereas in the recent past multiculturalism was viewed as an important characteristic of the post-apartheid South African society, now it is considered an impediment to learning and achievement (Nagao, Rogan and Magno, 2007: 79). Mda and Mothata (2000: 169) mention that the greatest obstacles in teaching multilingual classes in suburban and city schools are monolingual educators. They add that multilingual programmes cannot succeed in schools where educators belong to one racial, ethnic and linguistic group. Mulkeen (2010: 45) explains that the educator's ability to speak the home language of the learners helps to overcome ESL learners' difficulties in understanding the medium of instruction. Gamble (2004: 58) adds that educators can use the primary language of their learners to clarify concepts and promote learner understanding.

### **1.2.2 Medium of Instruction**

In the year 2000, the KwaZulu-Natal Minister of Education, Mrs Eileen Nkosi-Shandu, expressed concern that African learners were being disadvantaged by their parents' choice of English as the preferred language of instruction at schools (Layman, 2004). These parents realise the power and prestige of the English language and choose English medium schools, as a means of improving their childrens' educational and employment opportunities in the future (Nondo, 1996). To the contrary studies show that learners who learn

through a second language are disadvantaged especially since they have to make sense of the instructional tasks in the second language (Miti, 1995). When apartheid was abolished in the late 1980s many people expected black South Africans to choose an indigenous language as the national language, to replace English and Afrikaans (Balfour, 1999). However, English remained the *lingua franca* after 1994, not because the majority of South Africans understood it but because English was the language chosen by educated black South Africans at that time. Now, seventeen years into democracy, English as a national language has been held responsible for the erosion of the Zulu culture (Waka-Msimang, 1998) and has been blamed for poor matriculation results (Moreosole, 1998). Language expert Ekkerhard Wolff believes there is a direct link between the use of English as a medium of instruction and the high failure rates of second language learners. He compares the English medium of instruction to a 'form of self amputation' (Moreosole, 1998) that is stifling the progress of African learners. Research findings in Carletonville public schools in Gauteng show that poor English competence of African learners had lowered examination scores in English-medium schools (Hofmeyr, 2000).

### **1.2.3 The Effect of Language on Mathematics**

According to Orton (2004: 5-6), a major complexity in learning any school subject is its relationship with language learning. He adds that the effect of language on mathematics may be observed when a learner cannot master mathematics because the language used is not understood. Idris (2005: 114) explains that mathematics requires careful translation but if translation breaks down then misconceptions grow and mathematical thinking suffers. He says that mathematical sentences contain important meanings and information, learners therefore need time to absorb the meanings that are inherent in the mathematical vocabulary.

#### **1.2.4 The Effect of the Medium of Instruction on Mathematics**

Communicative competence in the language of mathematics is a necessary condition for mathematics learning (Meaney, Trinick and Fairhall, 2011: 236). Idris (2005: 115) adds that an inadequate grasp of the language of instruction contributes to underachievement in mathematics, since academic language used in mathematics may be difficult for learners to understand. In 1995, 1999 and 2003 South African learners participated in the Third International Mathematics and Science Study (TIMSS), an international study designed to measure learners' performance in mathematics and science. Plomp and Howie (2006: 78) compare the TIMSS tests to a horse-race with the media over-infatuated with the league table of achievement. They found that the medium of instruction at class level had a significant effect on South African learners' performance in mathematics. This is largely due to the fact that the majority of learners had to write the test in a second language, and ESL learners performed considerably poorly compared to mother tongue speakers of English.

#### **1.3 DEMARCATION OF THE PROBLEM**

The researcher has seventeen years of experience as a mathematics teacher and through interaction with other mathematics educators has found that many ESL learners experience difficulty in learning mathematical concepts, mainly due to poor comprehension of the English language. A section in the Grade 8 mathematics syllabus that is problematic is that of word problems. Language skills and particularly the reading skills needed to comprehend word problems are required by learners to learn and apply mathematical concepts (NCTM, 2007). Poor comprehension of the English language therefore results in ESL learners misunderstanding word problems. This was evident in South African learners' consistently poor performance in the TIMSS tests, indicating a strong relationship between language proficiency and performance in mathematics.

Many studies have been carried out to determine the level of difficulty language has been causing learners in their understanding of mathematics (Setati, 2003). The Third International Mathematics and Science Study (TIMSS) report in 1998 revealed that the language barrier is a cause of underachievement amongst South African ESL learners. Their poor performance in the 1995 and 1999 TIMSS tests is largely ascribed to the challenges that learners and educators have in studying and teaching through English as a second or even third language (Schafer, 2005). It is evident that parents of ESL learners are not taking note of these considerations when making a choice of school and medium of instruction for their children.

In 2006, South Africa participated in the Progress in International Reading Literacy Study (PIRLS), an international study of grade 4 learners' reading ability and attitudes (Mullis, Martin, Kennedy and Foy, 2007). Of the 38 countries that participated in the PIRLS South African learners achieved the worst results in spite of the fact that grade 5 learners were competing against grade 4 learners from the other countries (Howie, Venter, Van Staden, Zimmerman, Long, Scherman and Archer, 2007). Then in the UNESCO-UNICEF-Department of Education literacy and numeracy study of 1999 South African learners performed poorly, further strengthening the link between literacy and mathematics (PANSALB, 2000).

Grades 3 and 6 learners throughout South Africa took part in the Annual National Assessments (ANA) in February 2011. This was an initiative undertaken by the Department of Education to improve achievement in numeracy and literacy and to provide a benchmark for all schools in the basic education sector (<http://www.education.gov.za/>). The results were as follows: in Grade 3, the national average performance in literacy was 35% while in numeracy learners performed at an average of 28%, in Grade 6 the national average performance in the languages was 28% while for mathematics the average performance was 30% (Motshekga, 2011).

In light of the above, many initiatives have been undertaken in South Africa to improve performance in the languages and mathematics. These initiatives include the use of a multilingual resource book (Tokwe and Schafer, 2009), the teaching of language skills to ESL learners (Uys, Van der Walt, Van den Berg and Botha, 2007) and the introduction of a learning support educator in the classroom (Kruger and Yorke, 2010). The benefits of these initiatives with a view to helping educators address ESL learners' diverse needs are discussed in Chapter 2. Although research has been carried out to give teachers a working knowledge of teaching mathematics to ESL learners (NCTM, 2007), there is insufficient research on the difficulties experienced by ESL mathematics learners in solving word problems. To the best of the researcher's knowledge no research has been conducted on the performance of grade 8 ESL learners in the learning of mathematics word problems in South Africa. This study addresses that gap.

Word problems is a section in the Grade 8 Mathematics syllabus, that many ESL learners experience great difficulty in (Wetzel, 2008). A possible reason for this is ESL learners are already struggling with reading, writing and speaking in English. This is further compounded when they are expected to use basic comprehension skills to solve word problems. Educators, therefore, need to adapt their teaching strategies when teaching ESL learners how to solve word problems.

#### **1.4 THE RESEARCH AIMS AND OBJECTIVES**

The aim of this study was to investigate the challenges that mathematics educators are experiencing in teaching word problems to ESL Grade 8 learners, and to determine what teaching strategies may be used to help them solve word problems. This study focused on Grade 8 learners at ten secondary schools in the Mafukuzela–Gandhi Circuit which incorporates the areas of: Inanda, Ntuzuma, KwaMashu, Phoenix, Verulam and Tongaat.

In order to achieve the above aim, the following objectives were addressed:

- to identify ways in which ESL learners learn mathematics with special

- emphasis on word problems;
- to identify strategies that mathematics educators use to teach word problems to ESL learners; and
  - to identify challenges that mathematics educators and ESL learners encounter in the teaching and learning of word problems.

It is hoped that the findings of this research will make recommendations to: mathematics educators to enable them to adapt their teaching strategies to help ESL learners solve word problems, and to the Department of Education in respect of mathematics education with particular reference to word problems in the mathematics syllabus.

## **1.5 DEFINITION OF KEY TERMS**

### **1.5.1 African/Black**

In this study, use of the term 'Black' refers collectively to Africans, Indians and Coloureds while 'African' refers to the indigenous inhabitants of Africa. A major difference is that the home language of the 'African' learner is normally an indigenous language or English, Indian learners may have English or an Indian language as their home language, and Coloured learners generally have Afrikaans or English as their mother tongue.

### **1.5.2 ESL/EFL Learners**

English as a second language (ESL) learners refer to those learners whose home language is not English, but they are being taught through the medium of English at school, while English as a foreign language (EFL) learners refer to those learners who live in a country where their language is the primary medium of instruction but they may need to learn English for academic or employment purposes (Camenson, 2007: 2).

### **1.5.3 Multicultural Education**

Multicultural education is a system of instruction that acknowledges the differences between learners' races and cultures, and strives to meet their educational needs in a diverse society (Banks, 2004).

### **1.5.4 Multilingual Classrooms**

Multilingual classrooms are classrooms which consist of learners who speak a variety of first/home languages (Adler, 2001: 63).

### **1.5.5 Word Problems**

A word problem is a mathematical story with numbers and words (Everhart, 2011). Learners are expected to read and understand the sentences, before choosing an appropriate strategy to solve the word problem.

### **1.5.6 Words used interchangeably in this study**

The words 'maths' and 'mathematics,' 'teacher' and 'educator' are used interchangeably in this study.

## **1.6 OVERVIEW OF THE STUDY**

The first chapter outlined the context, rationale and significance of this study and presented a brief overview of the forthcoming chapters.

Chapter two presents a review of the literature pertinent to this study and discusses in detail the theoretical framework underpinning this study.

Chapter three describes the research framework, design and methodology.

Chapter four discusses the findings in this study.

The last chapter presents the research conclusions and makes recommendations for future research.



## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

The aim of this study was to identify the challenges experienced by English second language learners (ESL) and their educators in the learning and teaching of mathematics through the medium of English. To do this, the research was grounded within a theoretical framework and supported by a body of literature.

This chapter begins with a background of the education system in South Africa pre-and- post-1994 before investigating the link between language and education. This is followed by a discussion of the performance of South African learners in international benchmark tests. The next section discusses the role of language in mathematics with particular emphasis on word problems. The learning difficulties of ESL learners are then outlined and the chapter concludes with a discussion of the initiatives undertaken both in South Africa and internationally to help ESL learners learn mathematics through the medium of English.

#### **2.2 BACKGROUND**

South Africa is a country with a history of racism and racial subjugation, a country where black people endured approximately fifty years of domination by a white regime that skilfully manipulated every facet of their lives through an apartheid system (Morar, 2006: 245). Before the introduction of democracy in South Africa education was administered according to racial lines and by various central government departments (De Wet, 2011). Language was viewed as a controversial issue in South African education during this time (Alexander, 1989).

The only languages that were officially recognised were English and Afrikaans. Mother tongue education which emerged from the Bantu Education Act of 1953, was brought about by the apartheid government to support the educational goals of apartheid and to divide and rule its people (Broeder *et al.*, 1998). As a result, mother tongue education was seen by African parents as a means of denying their children access to the English language, to the *lingua franca* of South Africa, to a language of power and a language of wider communication (Broeder *et al.*, 1998).

Besides being denied access to the English language, the apartheid education system denied African learners access to schools of their choice. One focus of struggle in the South African education system was the Model C schools, an idea that was conceived in 1990 by the National Party's apartheid government in collaboration with the all-white Teacher's Federal Council as they saw power slipping away (Zindi, 1996: 76). According to Bush (2003: 76), the introduction of Model C schools in 1992 appeared to be the result of cutbacks in the budget for the white education department and the subsequent equal distribution of resources between the different education departments. Bush adds that this move to semi-privatise white schools was a means to maintain segregation and privilege. In general the South African education system pre-1994 was criticised for many reasons.

### **2.3 CRITICISMS AGAINST THE APARTHEID EDUCATION SYSTEM**

During the years of apartheid the South African education system was considered relatively advanced when compared to other African countries but at the same time it was criticised for the following reasons (Wolhuter, 1997):

- the education system was racially divided and marked by inequalities;
- white education prepared white children for positions of leadership, while black education deliberately trained black children for subordinate positions;
- the education system was teacher-dominated and focused on mastery of

- subject matter rather than on understanding and application of knowledge;
- education was used as a means of stifling critical thinking and freedom of expression;
  - segregated education emphasised cultural differences and excluded cultural heritage; and
  - the education system was too Eurocentric with learners learning very little about their own country.

In 1994, after years of protests, mass action, sanctions, world pressure, pressure by students and anti-apartheid activists apartheid was abolished (Morar, 2006: 245). This subsequently led to the South African government under the guidance of the 1996 Constitution passing legislation with respect to equality for all South Africans (Napier, 2010: 39).

## **2.4 THE SOUTH AFRICAN EDUCATION SYSTEM AFTER 1994**

Post-1994, African parents were allowed a say in their childrens' education and in the choice of the medium of instruction to be used at schools (Orman, 2008: 96). It was found that many African parents were choosing English as the medium of instruction for their children, mainly because they associate mother-tongue education with oppression, segregation and backwardness (Setati, 2008: 104; Dalvit and De Klerk, 2005; Nondo, 1996). When South African schools were opened to all races, the formerly whites-only English-medium schools were inundated with applications from non-white learners mainly because of the benefits these schools could offer to formerly disadvantaged black learners (Mda, 1997; Coutts, 1992). This was gradually extended to the former Indian and Coloured schools. Many former White, Indian and Coloured schools now have predominantly African learner enrolments, especially if they are close to African townships or the city.

According to Hofmeyr (2000) the changing status of learner enrolments in former White, Indian and Coloured schools has raised concerns about the ability of schools to cope with multicultural and multilingual classes. She adds that the poor English competence of African learners has lowered

examination scores in English medium public schools (see also Bosman, 2000). Even after the advent of educational reform in South Africa, the English language has been blamed for poor matriculation results (Heller, 1998: 801) and the erosion of traditional African culture (Waka-Msimang, 1998).

Many African parents still favour mother tongue education and would like their children to retain their cultural language (Nkabinde, 1997) but at the same time they acknowledge the power of the English language. As much as the English language has contributed to poor results, it is still viewed as a powerful language. Owing to socio-historical developments, the military power associated with English speaking nations and the socio-economic power of English dominated international companies, English has become the main language of international media and communications, international business and also academia (Smit, 2010: 2). English as an official language has been associated with success, prestige and progress (Schafer, 2005). Parents view English as the language that will allow their children access to participation in the international world (de Klerk, 2002). In fact, a survey carried out in Japan by the Ministry of Education, Culture, Sports, Science and Technology in 2004 found that 92% of parents support English education in elementary schools (Torikai, 2006). This is largely due to the fact that English has become the main language of international relations and in the global economy (Smit, 2010).

African parents encourage their children to study through the medium of English in the hope that English will provide them with education and employment opportunities in the future (Mda, 1997; Nondo, 1996). They feel that since English is the international and dominant language (Probyn, 2001), teaching should take place through the medium of English and should start as early as possible (Mda, 1997). Mathonsi asserts that the introduction of English at a very early age is having a negative impact on the performance of non-mother tongue speakers of English (Mbanjwa, 2011). Many schools are

aware of the repercussions but are still introducing English to primary school learners after only three years of schooling. In 2008, Setati (2008: 107) conducted a study among educators in multilingual township schools in South Africa and found that all teachers regarded English as the only choice for use in the teaching of mathematics - mainly because English is an international language. She was surprised that South African educators did not question the reasoning behind the fact that textbooks and examinations are administered only in English to African secondary school learners who may be experiencing difficulty understanding the English language.

Further studies conducted among South African learners showed that they preferred the use of English to the African languages in the learning of mathematics in secondary schools (Setati, 2005). Setati believes this is mainly due to the socio-political situation in South Africa. African parents see the African languages as having little or no social and economic benefits. Mbuyiseni Mathonsi, the provincial secretary of the South African Democratic Teachers Union (SADTU) has called for the language question to be addressed (Mbanjwa, 2011). He cites the use of English as a medium of instruction, as being a major hindrance to the improvement of education in South Africa and suggests the use of other languages as media of instruction in order to improve the quality of education (Mbanjwa, 2011).

There are other reasons why African parents prefer English-medium schools. Due to the injustices of the past, schools in previously disadvantaged areas may not have the same resources as English-medium schools (Olivier, 2006). Many African parents therefore feel that admission into an English-medium school gives the learner access to better educational resources and high quality of education (Feinberg and Lubienski, 2008). Makoni (2003: 8) concurs that English-medium schools receive more and better resources and have a higher level of professionally qualified educators. Baker (2005: 127) adds that African parents feel they are being shortchanged by the poor quality of education in township schools and are therefore choosing English-

medium schools because they have dedicated educators with a serious work ethic. In a bid to address the inequalities of apartheid education, the post-apartheid government embarked on a process of curriculum reform.

## **2.5 CURRICULUM REFORM IN SOUTH AFRICA**

The new democratically elected South African government was faced with the challenge of redressing the inequalities of the past and committed their attention to the following three issues: access to quality education; the introduction of a single, integrated education system; and a change from the traditional content-based National Education (NATED) 550 curriculum to Outcomes-Based Education (De Wet, 2011). It was envisaged that this new system would promote the principles of equality, desegregation, democratisation and multiculturalism (Geyser, 2000: 23).

### **2.5.1 Outcomes-based education**

The ANC government's decision to introduce Curriculum 2005 (C2005) signalled a dramatic break from the past and a deliberate attempt to catapult South Africa into the 21<sup>st</sup> century (Morar, 2006: 252). Four years into democracy, Outcomes-Based Education (OBE) which was also referred to as Curriculum 2005 (C2005) was introduced by the post-apartheid government as part of its programme to address the poor quality of education that many South African learners had been exposed to in the past (Department of Education, 2000). According to Mertens, Anfara and Roney (2009: 212), it was envisaged that C2005 would be fully implemented by the year 2005. This new curriculum was expected to reflect the values and principles of the new democratically elected government (Maree, Aldous, Hattingh, Swanepoel and Van der Linde, 2006).

In Curriculum 2005, differences between the old apartheid education and the new educational approaches were pointed out. On the one hand, apartheid education promoted passive learning, rote-learning, teacher-centredness, and rigid content based syllabi and curricula. On the other hand, OBE is said

to stand for learner-centredness, democratic curricula/programmes, active participation, critical thinking, reasoning, reflection and action (Nekhwevha, 1999: 500).

The OBE system which is based on the acquisition of knowledge, skills, values and attitudes, was learner-centred and asserts that all learners have the ability to succeed (Maree *et al.*, 2006). The OBE methods are unlike the older traditional teaching methods used in the NATED 550 curriculum, which focused on the direct instruction of facts and the mastery of subject content. Instead educators are expected to introduce real-life mathematics into classrooms and help learners acquire the necessary vocabulary and skills that will prepare them to become life-long learners and critical thinkers (Van der Walt, Maree and Ellis, 2008). Unfortunately not all educators welcomed the introduction of OBE.

Educators and other stakeholders in education believe that the OBE system and C2005 were hastily developed to reflect the values of South Africa's new democracy (Govender, 2008). This subsequently led to the OBE system being criticised for not producing the desired results in South Africa (Maree *et al.*, 2006). It was found that the OBE approach resulted in the lowering of educational standards since learners possess varying competencies, and were therefore incapable of all achieving the same high standards (Geyser, 2000: 39). Investigations into the implementation of the OBE curriculum revealed that: there were little or no teaching and learning support materials; there was a shortage of furniture in many schools; class sizes were large; multilingual classes placed language demands on the educator; educators were heavily burdened with paperwork and many educators indicated they did not receive sufficient guidance and were not confident to teach the new curriculum (Velupillai, 2006; Donnelly, 2005; Jansen, 1999). Criticisms against the OBE system and C2005 subsequently led to its implementation being reviewed.

### **2.5.2 Revised National Curriculum Statements**

In 2000 the Minister of Education, Professor Kader Asmal, set up a Review Committee to investigate the implementation of C2005 (Reddy, 2006). The Review Committee in their C2005 Review Report (DoE, 2000) recommended that the curriculum and its language be simplified, that the new curriculum incorporate more content, encourage reading, and provide educators with teaching and learning support materials. It was also suggested that the number of learning areas be reduced and that educators be adequately trained to implement the new curriculum.

In 2002, the Revised National Curriculum Statement (RNCS) was produced based on the recommendations of the C2005 Review Committee (Reddy, 2006). The main aim of the RNCS was to assist educators in their teaching and to improve the performance of learners (DoE, 2000). From 2002, following the recommendations of the C2005 Review Committee educators made use of the following three documents: NATED 550 (the curriculum that was used before C2005 was introduced), Curriculum 2005 and the RNCS to guide their teaching (DoE, 2002). After its implementation however, the RNCS was viewed as burdensome and was criticised by educators and other stakeholders.

According to New and Cochran (2007) the RNCS is an enormously complicated document which has resulted in South African teachers either struggling to understand its complex terminology, or being confused about the design and implementation of the new curriculum. The RNCS was criticised for increasing educators' workloads, for causing confusion amongst educators, and for learners' poor performance in national and international tests (DoE, 2002). This led to the Minister of Basic Education, Minister Angie Motshekga, appointing a panel in July 2009 to investigate the challenges experienced by educators in implementing the RNCS (DoE, 2009).



The panel found that:

- many educators did not implement the RNCS but continued teaching C2005;
- the majority of subject advisors lacked the necessary skills to support educators;
- educators were producing their own teaching materials; and
- newly qualified educators were unprepared to teach the new curriculum.

The task team for the review of the implementation of the RNCS (DoE, 2009) recommended the following plan to improve teaching and learning at schools:

- Phase 1: Clearly outline what educators should be teaching
- Phase 2: Clarify the roles of the various role players, provide textbooks as well as training for unqualified or poorly qualified educators
- Phase 3: Implement a national testing programme to assess learner progress and the success of the curriculum

### **2.5.3 Schooling 2025**

In keeping with the recommendations of the task team for the review of the implementation of the RNCS, the Minister of Basic Education, Minister Angie Motshekga, announced in 2010 that the OBE system would be revised and renamed Schooling 2025. Schooling 2025 which will begin in 2012, aims to improve educator recruitment, learner enrolment, school funding, mass literacy and numeracy, and the overall quality of education (National Education Policy Act, 2010).

In 2010, the Council of Education Ministers approved the recommendation that from 2012, the language chosen by the learner as a language of learning and teaching from grade 4 shall be taught as a subject from Grade 1, and not from Grade 3 as is currently the case (Department of Basic Education, 2011b). Schooling 2025 places emphasis on the role of language in education. In a statement made by Motshekga (DBE, 2011b) on the release

of the Annual National Assessments, she mentioned that the new curriculum will allow African learners the option of learning in their mother tongue for the first three years of their schooling. During the foundation phase, English may be taught concurrently with the mother tongue but will not replace the mother tongue (DBE, 2010). In cases where the language of learning and teaching will be English from Grade 4 onwards, those learners will be required to take English as a subject from Grade 1 (DBE, 2011b). Lesson plans will be provided to educators in order to improve learners' performance in literacy and numeracy, and learning and teaching materials will be developed, translated and distributed to educators and learners (DBE, 2010).

The Schooling 2025 campaign aims to address differentiation of educational standards in an attempt to improve the performance of all learners over the following 12 years (DBE, 2010). In South Africa it is not only performance in primary schools that is cause for concern but poor matriculation results, especially in mathematics, is resulting in matriculants not gaining acceptance into higher education institutions.

## **2.6 POOR MATRIC RESULTS IN SOUTH AFRICA**

De Wet (2011) believes that poor matriculation results can be attributed to problems which surfaced at primary school level. She believes that when the foundations for reading, writing and numerical skills are inadequate, learners complete the primary school phase without having fully mastered these skills. According to the Organisation for Economic Co-operation and Development (OECD, 2008: 194), learners carry their lack of skills to the next grade. When they reach secondary school, it is impossible to catch up on these skills. This results in a large number of learners dropping out or failing the matric exam (Steyn and Maree, 2003).

Presently the failure rate in mathematics at South African schools is very high (Maree *et al.*, 2006). Maree *et al.* (2006) list the following factors that contribute to learners' poor performance: poor socio-economic background of

learners; lack of appropriate learning and teaching support materials; educators' poor knowledge of subject matter; lack of motivation of educators; poor study habits among learners; and the language of instruction at school being different from learners' mother tongue. Poor results in turn have implications for matriculants' admission into higher education institutions.

### **2.6.1 Admission into Higher Education Institutions**

According to Section 37 of the 1997 Higher Education Act, all universities in South Africa are required to comply with appropriate measures for the redress of past inequalities (February, 2010: 77). This gave rise to the quota system which many universities have incorporated into their admissions policy to make the racial composition of the university conform to that of society (Fobanjong, 2001: 148). The university quota system in South Africa thus reserves most places for African learners in the various faculties, however only a small percentage of African learners are passing mathematics at matric level and gaining acceptance into these faculties (Howie, 2003a). Van der Berg (2001: 177) expresses concern that few schools serving mainly African learners provide a strong foundation in mathematics and science. Higher education institutions and employers have highlighted matriculants' lack of basic skills in mathematics and literacy. Learners' consistently low scores in mathematics and literacy impact at tertiary level where poor matriculation results in turn lead to poor university preparation and high drop-out rates (Maree *et al.*, 2006). This has resulted in universities and universities of technology introducing entrance exams to weed out poorly qualified matriculants (Kivilu, 2006).

Setati, a prominent South African researcher in the field of mathematics teaching and learning in multilingual classrooms (Murad, 2009: 55) mentions that the performance of African learners in mathematics and science is significantly lower than that of white learners (Bowman, 2010). She describes the present situation as a crisis since the majority of our population is African. She adds that African learners are not meeting the criteria to be accepted

into the engineering and medical faculties. The OECD (2008: 204) concurs that the technological and scientific fields of study are out of reach for many African learners. This is possibly due to the fact that there is still a large gap between the quality of education provided for African and white learners (Powell, 2002) which subsequently reduces employment opportunities for African learners compared to white learners.

The next section outlines the language policies put in place by the Department of Education, and the government's commitment to promote and preserve the African languages.

## **2.7 LANGUAGE AND EDUCATION IN SOUTH AFRICA**

### **2.7.1 Language Policy in South African Schools**

In 1997 the Minister of Education introduced a new multilingual language policy which gave support to the learning of more than one language, and to the maintenance of the home language while providing access to the other languages (Bengu, 1997: 1). South Africa has eleven official languages as well as other unofficial languages and a range of diverse cultures. The new policy recognised the eleven official languages and allowed the learner or parent to choose the language of learning and teaching (LoLT) from these official languages (Webb, 2002: 178).

According to the South African Schools Act (Act 84 of 1996) education must serve to protect and advance our diverse cultures and languages and uphold the rights of learners, parents and educators. With respect to minority groups and minority languages in South Africa, there has been much debate regarding their rights. In 2011 a group of Indian educators made a submission to the Department of Education to include the Indian languages in the new curriculum which will be implemented in 2012 ([www.indianexpress.com/...indian\\_languages.../747402/](http://www.indianexpress.com/...indian_languages.../747402/) - United States). The educators argue that if the Indian languages are not included as school subjects they are likely to die out in the next 50 years. However this

discussion is outside the ambit of this research and will therefore not be discussed any further.

### **2.7.2 The Language-in-Education Policy**

The objective of the South African Schools Act (Act 84 of 1996) is to provide a strong foundation for the protection and advancement of the country's diverse cultures and languages. To achieve this aim the Language Plan Task Group (LANGTAG) was established in 1995 by the Department of Arts, Culture, Science and Technology and the Department of Education to identify language-related needs and principles for all spheres of South African society (Mda, 1997). In 1997 the Language-in-Education Policy (LiEP) was developed. According to Mda (1997), the main aim of the LiEP was to address the disadvantages resulting from mismatches between learners' home languages and the languages of learning and teaching at school. The underlying principle was to retain the learners' home language for learning and teaching and to encourage learners to acquire proficiency in additional languages (Department of Arts and Culture, 2003). Although the LiEP insists that the language of learning and teaching in the first four years of schooling should be mother tongue, this is not the case in African schools in South Africa. Code-switching between English and the African languages is common in schools where the home language of educators and learners is not English and sometimes starts as early as the junior primary phase. Code-switching is the practice where the educator alternates between two or more languages (Baker, 1993). This is often practiced by African educators in South Africa and may continue for the full duration of schooling.

The LiEP Act allows learners the right to be taught in a language of their choice. This implies that learners have a right to be taught in their mother tongue whilst having access to an international language such as English (DoE, 1997). Learners ought to inform the school about their choice when they apply for admission at the school. The governing bodies, in turn, must take learners' preferences into account when drawing up the language policy

for their school. Section 6 of the South African Schools Act (Act 84 of 1996) entrusts school governing bodies with the authority to determine the language policy of schools within guidelines set at national and provincial level. They are expected to indicate how the school will promote multilingualism by using more than one language of learning and teaching.

In spite of the government's commitment to protect all languages, the education sector still does not reflect the multilingual nature of South Africa. The dominant status of English has led to South Africans having a negative attitude towards the African languages (Setati, 2003) and points to the need for deliberate attempts to promote the African languages in South Africa.

### **2.7.3 Promotion of the African Languages**

The Pan South African Language Board (PANSALB) was entrusted with the responsibility of advising government on language issues, especially those languages that did not enjoy official status before 1994 (PANSALB Act, 1995). PANSALB expressed support of the principles mentioned in the LiEP, that the use of the mother tongue should be maintained throughout schooling and that an additional language should be introduced to enhance the communicative ability of the learner.

Many linguists agree that mother tongue education in the primary years is useful in the acquisition of English as a second language (Brock–Utne, 2002: 16) and that the mother tongue should be extended to as late a stage in education as possible (Coutts, 1992). Also research on second language acquisition shows that if a child masters the first language then learning another language becomes less problematic since habits of speech, listening, reading and writing can be transferred to the learning of the second language (Cummins, 1981).

The UNESCO Committee of 1953 agreed that the best medium for teaching a child is the mother tongue, since children are able to understand the subject matter better and express themselves freely. Studies in favour of the

mother tongue over English second language in Bengali schools reveal that important ideas were more easily conveyed through the mother tongue than through English (Maniruzzaman, 2010: 8). Collier and Thomas (2004, 20) found that only those learners who had 5 to 6 years of strong cognitive and academic development through their mother tongue, as well as through the language of instruction did well in their assessments. This strengthens the belief that strong education programmes in the mother tongue help second language learners gain confidence in using the new language for communication and for learning new concepts. The move to introduce mother tongue education in primary schools will be addressed by the Schooling 2025 curriculum which will allow African learners the option of learning in their mother tongue for the first three years of their schooling (DBE, 2011b).

More can be done towards promoting the African languages in South African schools (Bosman, 2000). Outdated and irrelevant syllabi as well as the lack of or shortage of standardized textbooks are causing African learners to reject the African languages in favour of English (Broeder *et al.*, 1998). Research by de Klerk (2000) affirms that unless the syllabi are revised there will be a shift away from African languages which will eventually lead to language death. There is an urgent need to revise the syllabi to prevent African languages from being phased out. Having discussed languages and education in South Africa, it is necessary to consider learners' performance in the global arena. The following section of this chapter therefore describes the performance of South African learners in international tests. Participation in international educational studies such as the Third International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS) allows for scrutiny and critical analysis of a country's national curriculum (Beaton, Postlethwaite, Ross, Spearritt and Wolf, 1999).

## **2.8 SOUTH AFRICA'S PERFORMANCE IN INTERNATIONAL STUDIES**

According to Reddy (2006), countries undertake national assessments and systemic evaluation of their educational system to monitor the performance of that system, improve accountability, and identify opportunities for improving learning outcomes. Reddy (2006) defines a national assessment in education as the process of obtaining relevant information from the entire education system within a nation with the aim of evaluating the performance of learners and other important roleplayers for the purpose of improving teaching and learning. The National Education Policy Act of 1996 (Act No. 27 of 1996) makes provision for the Department of Education to conduct national assessments (DoE, 1998). This implies that the government and the Department of Education are also held accountable for improving the quality of education in the country (Kanjee, 2005). Several studies conducted in South Africa have reported shortcomings in the numeracy and literacy learning competencies of South African learners (Mji and Makgato, 2006; UNESCO/UNICEF: Monitoring Learning Achievement Project, 2005; Howie, 2003b).

National and international studies provide feedback on what learners have and have not mastered in comparison to other countries (OECD, 2008: 207). South African learners' performance in national and international tests will now be discussed.

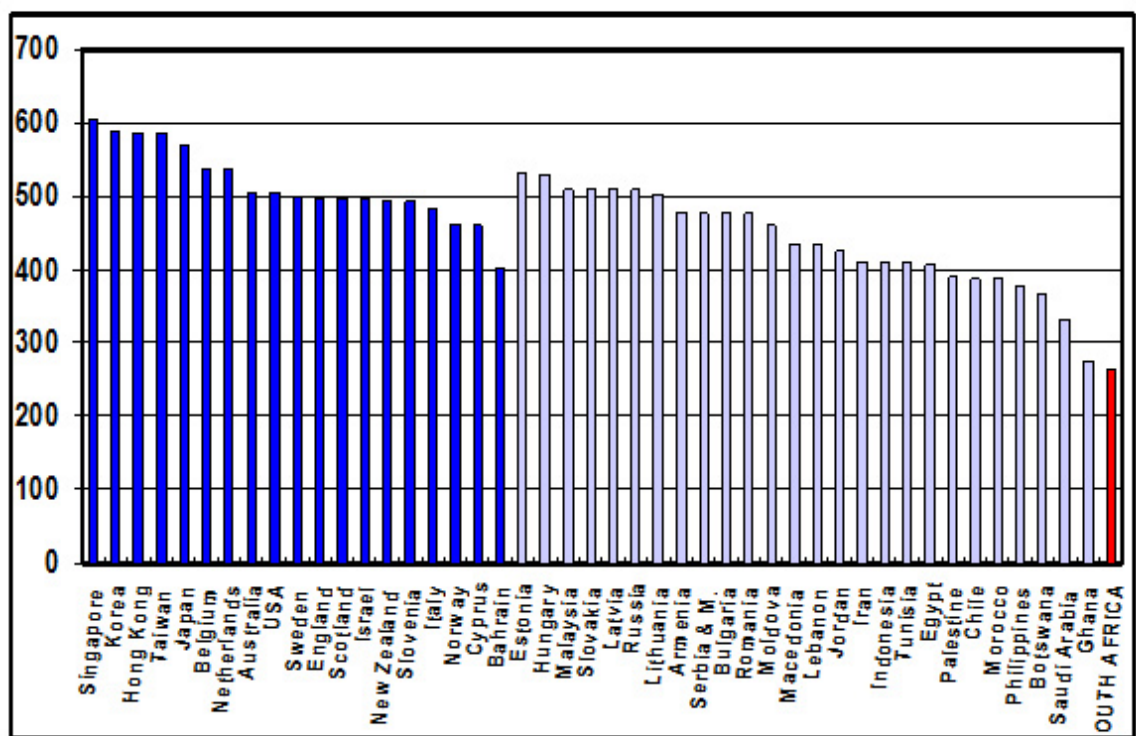
### **2.8.1 TIMSS**

The Third International Mathematics and Science Study (TIMSS) is an international study that measures grades 4 and 8 learners' performance in mathematics and science. TIMSS was first conducted in countries internationally in 1995 and was thereafter administered every 4 years. The TIMSS tests which were conducted by the International Association for the Evaluation of Educational Achievement (IEA), allowed South Africa an opportunity to obtain a national assessment of their learners' performance in



mathematics and science (Howie, 2002). The Third International Mathematics and Science Study (TIMSS) in 1995, the Third International Mathematics and Science Study - Repeat (TIMSS-R) in 1999, and the Trends in Mathematics and Science Study (2003) found that South African learners performed extremely poorly in comparison with other participating countries (Howie, 1997; 2001; 2002). Test results revealed that South African learners repeatedly came last (Bansilal, James and Naidoo, 2010; Mji and Makgato, 2006).

**Fig. 1: Mean Mathematics achievement in TIMSS (Grade 8)**



Source: <http://www0.sun.ac.za/research/en/eradication-of-poverty-and-related-conditions-/103-the-vicious-cycle-of-poverty-weak-education-and-weak-labour-market-performance>.

Figure 1 (above) shows the results for mathematics in the TIMSS study in 1995. A closer analysis of the results revealed that learners experienced challenges relating to their limited vocabulary of mathematical terms - for

example, when they had to understand word problems, to discuss the solutions to the problems, and to write down the solutions (Maree *et al.*, 2006). South African learners struggled most in dealing with problems involving language - they experienced difficulty communicating their answers in the language of the test (English), and they revealed a lack of knowledge of the basic mathematical skills (Van der Walt *et al.*, 2008).

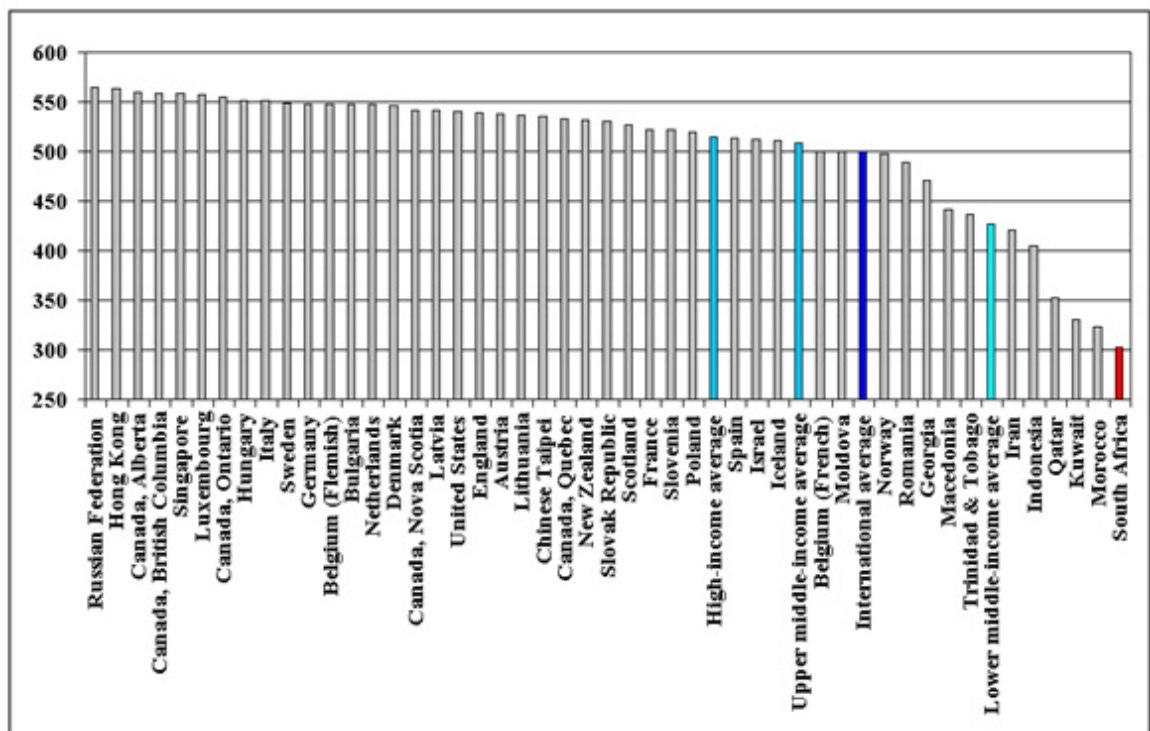
In TIMSS-R in 1999 South African learners completed a language proficiency test in English, allowing researchers the opportunity to investigate the relationship between proficiency in the English language and mathematics and science achievement. In general it was found that South African learners lacked basic mathematical skills that are required for their particular grades. Again ESL learners struggled with the problems involving language (Maree *et al.*, 2006). As a result they were unable to understand many of the questions and experienced difficulty explaining answers to the open ended questions. Other reasons cited for poor performance were large class sizes and unqualified or poorly qualified educators.

According to the World Bank (2010: 174) many children in developing countries face a significant hurdle when they enter formal schooling because the language of instruction is not spoken at home. Reddy (2006) confirms that in countries where a large proportion of learners are from homes where the language of the test, which is generally the language of teaching and learning in school, is not spoken at home the mathematics and science achievement scores are generally lower. He adds that learners who speak the language of the test at home achieve better results than those who do not speak the language of the test. Taylor *et al.* (2003: 54) explain it is highly probable that the difficulties associated with studying in a language other than one's home language are more pronounced in subjects like mathematics and science, which are strongly dependent on technical language proficiency which is dependent upon prior proficiency in the language of instruction.

## 2.8.2 PIRLS

Research into South Africa's performance in international tests revealed that the subject matter knowledge of the majority of learners is poor (Howie, 2002; 2003b). The Progress in International Reading Literacy Study (PIRLS) is an international study of grade 4 learners' reading ability and attitudes (Mullis *et al.*, 2007). In South Africa the PIRLS (2006) was conducted by the Centre for Evaluation and Assessment (CEA) under the auspices of the International Association for the Evaluation of Educational Achievement (IEA) (Howie *et al.*, 2007).

Fig. 2: Mean reading achievement score in PIRLS (Grade 5 for South Africa, Grade 4 for most other countries)



Source: <http://www0.sun.ac.za/research/en/eradication-of-poverty-and-related-conditions-/103-the-vicious-cycle-of-poverty-weak-education-and-weak-labour-market-performance>

According to Howie *et al.* (2007), the four reading processes addressed by PIRLS are: the retrieving of explicitly stated information, making inferences, interpreting ideas and information, examining and evaluating content. In 2006, 38 countries participated in the PIRLS. South African learners achieved the worst results in spite of the fact that grade 5 learners were competing against grade 4 learners from the other countries (Howie *et al.*, 2007). Figure 2 (on page 28) shows the results for reading in the PIRLS.

### **2.8.3 Annual National Assessments**

About six million grades 3 and 6 learners throughout South Africa took part in the Annual National Assessments (ANA) in February 2011. This was one of the strategies introduced by the Department of Education to improve achievement in numeracy and literacy and to provide a benchmark for all schools in the basic education sector. The ANA was intended to provide valid and reliable data on pupil achievement in the education system. The purpose of these assessments are to enable district offices to determine where support is needed and will allow principals, teachers and parents to measure progress and take steps to improve learner performance and the quality of education in the country (<http://www.education.gov.za/>). The Department of Education had set a target of improving results in numeracy and literacy of grades 3 and 6 learners from the previous average attainment levels of between 27 % and 38 % to at least 60% by 2014 (<http://www.education.gov.za/>).

The results for the 2011 ANA tests are as follows: in grade 3, the national average performance in literacy was 35% and in numeracy they obtained an average of 28%, while in grade 6 the national average performance in the languages was 28% and the average performance in mathematics was 30% (Motshekga, 2011). Once again, as in previous national and international tests, the results of the ANA reveal that South African learners are performing dismally in the languages and mathematics.

In the recent past, multiculturalism was viewed as an important characteristic of the post-apartheid South African society but is now considered an impediment to learning and achievement (Malcolm and Alant, 2007: 79). The link between language proficiency and mathematics proficiency, as well as the learning difficulties of ESL learners will now be outlined.

## **2.9 MATHEMATICS AND LANGUAGE**

Mathematics educators in South Africa, and in many other countries, manage their teaching in multilingual settings. Adler (2001: 35) suggests that the dynamics of teaching and learning in multilingual mathematics classrooms be investigated, focussing on what educators have learned and what they prioritise.

Mathematics is a complex and difficult subject for many learners since it has its own specialized language (Solano-Flores, 2010). The mathematical terms are unfamiliar especially to ESL learners and will therefore need to be explicitly explained in order to help them understand mathematical concepts (Frei, 2007: 85). Mathematics also involves critical thinking, reasoning and problem-solving (Irujo, 2007). MacGregor and Price (1999) found that lower language proficiency results in poor performance in mathematics thereby suggesting a link between language proficiency and mathematics proficiency. Studies show that children must be able to read and write before they can learn mathematics and that mathematics will improve as language improves (Coutts, 1992). Coutts also found that grade 4 learners in South Africa performed poorly in word recognition (1992: 59).

Word recognition is defined as the ability to pronounce and determine the meaning of a word (Kurvers, 2007). It stands to reason that learners' understanding of the content must be poor since word recognition and reading comprehension are linked (Snow, Porche, Tabors and Harris, 2007).

Miti (1995) agrees that learners who learn through a second language are disadvantaged. Studies conducted among bilingual and multilingual learners reveal that learners who are weak in the language of instruction tend to have poor comprehension skills and do not participate in classroom activities thereby contributing to their poor performance (Setati, 2003; Secada, 1992).

A section in mathematics that requires understanding of the subject content is that of word problems. The following section outlines some of the challenges experienced by ESL learners and their mathematics educators in the learning and teaching of word problems.

## **2.10 TEACHING WORD PROBLEMS TO SECOND LANGUAGE LEARNERS**

Language skills and reading skills needed to comprehend word problems and the listening skills required to understand the educator's explanation of the solution, are the means through which learners learn and apply problem-solving skills (Crandall, Dale, Rhodes and Spanos, 1985). Since language is an important resource in teaching and learning mathematics, educators are able to help learners most when they support them in learning mathematical language with meaning and fluency (NCTM, 2007).

According to the National Council of Teachers of Mathematics (NCTM) Research Journal, communication is an important part of classrooms in which learners are engaged in challenging mathematics (NCTM, 2000). Classrooms with ESL learners are further challenged since mathematics educators need to understand learners' language difficulties and use learners' linguistic strengths and experiences in the teaching of mathematics (NCTM, 2007). Teaching can also become frustrating and time-consuming for the educator who has the task of teaching both mathematics and English at the same time (Setati and Adler, 2001). Unfortunately mathematics syllabi across all grades are generally quite long and teachers do not have the

luxury of time when teaching second language learners.

When ESL learners do not participate in classroom activities, mathematics educators may find it difficult to correctly assess the cause of learner difficulty. They may be unsure as to whether it is the mathematics or the language barrier that has led to challenges in the mathematics classroom (Secada and Cruz, 2000). Learning mathematics in English can become very frustrating for ESL learners since they are likely to experience difficulty understanding mathematics through a medium of instruction that is different from their mother tongue (Hyerle, 2008: 128). They also have to cope with the difficulty of learning the special terminology used in mathematics (Brodie, 1989). Another challenge is that learners may know the answer to a question but may find it difficult to respond in the classroom due to the lack of proficiency in the English language. Naude (2004: 122) agrees that limited language proficiency can pose a barrier to using mathematics effectively as a communication and problem-solving tool.

According to Bialystok (2001: 18), 'language proficiency' is the ability to function in a situation that is defined by specific cognitive and linguistic demands, to a level of performance indicated by either objective criteria or normative standards. As a result ESL learners may find it difficult to perform at the same academic level as their peers. Cummins (2000) differentiates between two types of language proficiencies for ESL learners: Basic Interpersonal Communication Skills (BICS) and Cognitive Academic Language Proficiency (CALP).

BICS is social communication language, the language used to "fit in" with peers or the language needed to successfully complete daily activities such as shopping, ordering at a restaurant, or opening a bank account (Grassi and Barker, 2010: 78). BICS refers to the language used in informal and social settings to carry out conversations (Cummins, 2000). Learners in the school situation would make use of BICS when speaking informally to other learners

and to their educators. Even when learners have acquired communicative proficiency, this does not necessary guarantee that they will be able to perform academic tasks and pass their examinations (Grassi and Barker, 2010: 78).

The second type of language skills, CALP, consists of the language skills needed to do schoolwork. Attaining this type of proficiency is critical in order for the ESL learner to make academic progress (Rhodes, Ochoa and Ortiz, 2005: 70). Although there is no sequential order in the acquisition of BICS and CALP, most often children develop fluency in English before being able to perform academic tasks in this language (Gallagher, 2008: 37). Since language and thinking are closely linked, CALP involves processes that are required for academic achievement (Cummins, 2000).

The language difficulties of ESL learners is an international dilemma. It is therefore important to investigate the initiatives undertaken both internationally and in South Africa to help these learners.

## **2.11 INTERNATIONAL INITIATIVES IN MATHEMATICS AND LANGUAGE**

This section discusses the teaching strategies that have been employed internationally to help ESL learners with their language difficulties. In the Czech Republic, Content and Language Integrated Learning helped ESL learners to gain competence in English while in California a resource titled 'Accelerating academic language development: Six key strategies for educators of English learners' proved effective in developing English as a second language. The introduction of a two-semester English programme at the King Fahd University in Saudi Arabia and the translation and simplification of English words in Spain contributed to an improvement in ESL learners' performance in mathematics. It is important for educators to examine the initiatives being employed in these countries in order to help ESL learners gain fluency and meaning in the English language.



## **2.11.1 Initiatives Undertaken Internationally**

### *2.11.1.1 Content and Language Integrated Learning in the Czech Republic*

One of the approaches used in the teaching of foreign languages in the Czech Republic is Content and Language Integrated Learning (CLIL). CLIL aims to create an improvement in both the foreign language and the non-language area competence (Novotna, Hadj-Moussova and Hofmannova, 2001). The CLIL teacher training programme encourages interaction of the mother tongue (Czech), the foreign language (English) and the language of the content area (mathematics) and aims to give teacher trainees insight into both the theoretical and practical aspects of CLIL. The course pays attention to the advantages, disadvantages and challenges that might occur in the mathematics classroom, and investigates the differences in the educator's work when teaching in Czech and in English (Novotna and Hofmannova, 2000).

CLIL is an interactive teaching style that promotes holistic ways of learning and provides young learners with opportunities to learn from practical, hands-on experiences. Educators involved in the programme exhibit active teaching behaviours such as clearly giving instructions, accurately describing tasks, and maintaining learners' involvement in instructional tasks (Naves, 2002). Throughout the course emphasis is placed on the learners' comprehension, so future educators will need to learn how to adapt their teaching styles towards the use of interactive teaching strategies. They need to use a variety of verbal and non-verbal means such as repetition, rephrasing, gestures, body language, analogies and representation to illustrate meaning (Novotna and Hofmannova, 2000). Verbal input is accompanied by the use of visual and multimedia aids.

### *2.11.1.2 Accelerating Academic Language Development in California*

The New Teacher Center (NTC) established in 1988 at the University of California supports new educators and administrators by training a select

group of outstanding teachers and administrators from various schools to observe and mentor new educators and administrators (Jonson, 2008). They developed a resource titled 'Accelerating academic language development: Six key strategies for educators of English learners.' The six strategies based on research studies that identify effective methods for developing English-language learners' content were: vocabulary and language development; guided interaction; metacognition and authentic assessment; explicit instruction; the use of meaning-based context and universal themes; and the use of modelling, graphic organizers and visuals (Bongolan, Moir and Baron, 2009: 224).

It was found that the six key strategies helped learners develop English as a second language as well as learn academic language. Also, new educators, their mentors and administrators were able to plan, reflect on and observe the classroom activities with the aim of improving learners' language development and content learning (Bongolan *et al.*, 2009: 224). After running the NTC programme for seven years, the co-ordinators were pleased to note its positive impact on the teaching profession.

#### *2.11.1.3 Language and Mathematics in Saudi Arabia*

At the King Fahd University of Petroleum and Minerals (KFUPM) in Saudi Arabia, an experiment was carried out with the aim of reducing the language difficulties of first year students (Yushau and Bokhari, 2005). Students completed their high school studies in Arabic and then went on to study at KFUPM where English was used as the medium of instruction. To prepare students for this change, they took a two-semester English programme. At the same time they were required to take one mathematics course per semester which was taught in English. Due to the language barrier, the students faced severe challenges while taking the preparatory mathematics courses. As part of the experiment, the university translated all the key terms of the entire mathematics course from English to Arabic. This was prepared in a handout and given to students. The university also designed

transparencies for the lectures in which an Arabic translation was inserted after each key technical term. English remained the medium of instruction throughout the experiment.

One of the findings of the experiment was that the insertion of the Arabic translation helped the students to recall the mathematical concepts learnt at high school level. This helped them to connect their previous knowledge with current knowledge, and to attempt mathematical problems. There was also an increase in class participation and an overall improvement of students' performance in the examinations (Yushau and Bokhari, 2005).

#### *2.11.1.4 Teaching Mathematics to English Language Learners in Spain*

Since mathematics deals primarily with numbers, many people involved in education used to think that mathematics is nonverbal and less language-dependent when compared with other school subjects. In the 1970s primary school learners in bilingual classes in Spain were expected to learn mathematics from nonverbal textbooks. It was then that Irujo (2007) found that English language learners experienced difficulty in solving word problems. The learning material that was used took the form of programmed instruction texts that broke down calculations into smaller parts and steps, which learners copied then attempted on their own. The texts covered the four operations in mathematics: addition, subtraction, multiplication and division.

Suzanne Irujo, a primary school educator found that her third and fourth grade learners became very bored, so she began using grade-level mathematics textbooks in English (Irujo, 2007). She taught the lessons in Spanish and translated the word problems into English. Although the English textbooks proved to be more effective than the nonverbal texts, the lessons became very laborious. Irujo was teaching in Spanish on one day, then teaching in English on the following day in order to prepare the learners for lessons taught completely in English.

Solving word problems require learners to understand the language, identify the maths relationships and then convert these to symbol form (Irujo, 2007). To address the difficulties learners experience in solving word problems, studies by Celedon-Pattichis (2003: 59) to find out what strategies English language learners used to approach word problems revealed that they used strategies such as reading the problem twice, translating the problem from English to Spanish, inferring meaning, using symbols to understand the mathematics and ignoring irrelevant words. Irujo (2007) found that word problems which describe realistic situations makes it easier for the learners to understand the problem and transfer problem-solving skills learnt in previous activities.

To address the challenges that learners and teachers experience in studying and teaching through English as a second or third language, a number of initiatives have been undertaken locally. The next section outlines some local initiatives that have proven to be successful.

### **2.11.2 Initiatives in South Africa**

On the local front, initiatives worth mentioning include the use of a multilingual resource book (Tokwe and Schafer, 2009), the teaching of language skills to ESL learners (Uys *et al.*, 2007) and the introduction of a learning support educator in the classroom (Kruger and Yorke, 2010). The benefits of these initiatives are discussed with a view to helping educators address ESL learners' diverse needs.

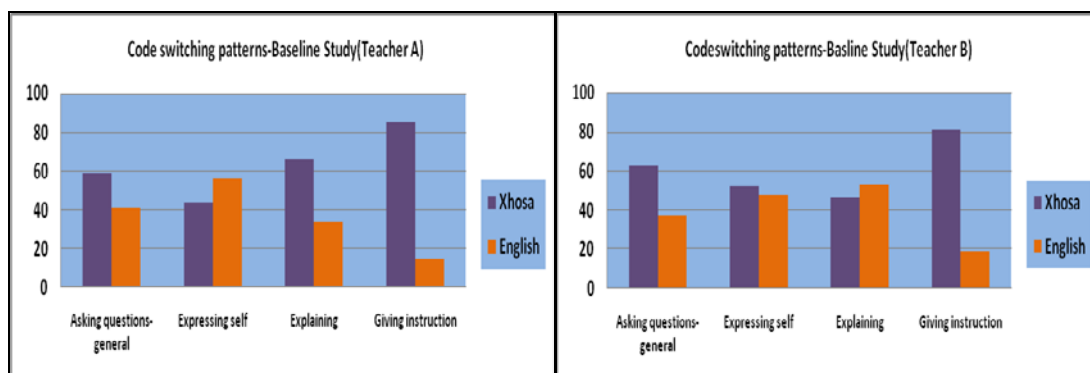
#### *2.11.2.1 Experiences with a Multilingual Resource Book*

A multilingual learning and teaching resource and support book (Grades 9-10) was developed at the Centre for Applied Language and Literacy Studies and Services in Africa (CALLSSA) at the University of Cape Town in collaboration with Rhodes University and the University of KwaZulu-Natal. The book was introduced to provide the meanings of key mathematics and science concepts in isiZulu, isiXhosa, Afrikaans and English. The research

process that followed involved the participation of grade 10 educators in KwaZulu-Natal, Eastern Cape and Western Cape.

Pilot research into the effectiveness of the Concept Literacy Resource book explored how the book impacted on the code-switching practices of isiXhosa speaking grade 10 mathematics educators (Tokwe and Schafer, 2009). Four educators were involved in the pilot study: A, B, Y and Z. Their code-switching practices were observed over a number of lessons before the Concept Literacy book was introduced to two of the four educators, Y and Z. Figure 3 (below) illustrates the code-switching practices of educators A and B. Figure 4 (overleaf) illustrates the code-switching practices of educators Y and Z after the Concept Literacy Resource book had been used over two terms.

*Figure 3: The Code-Switching Practices of Educators A and B*



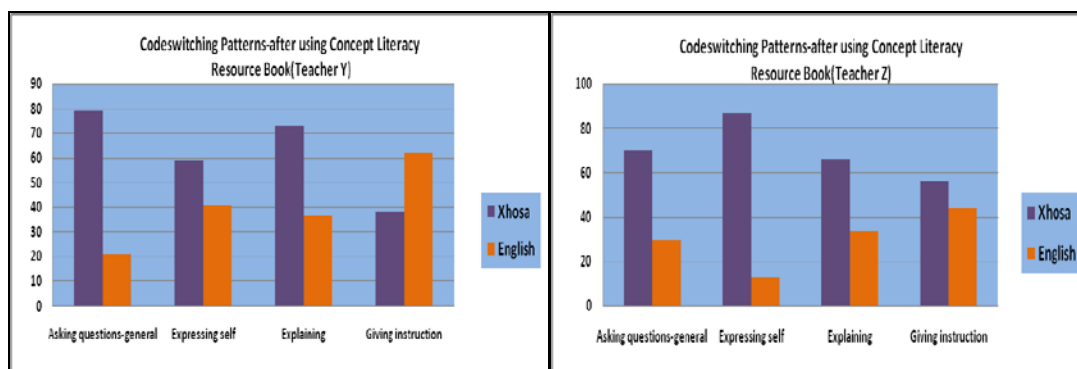
*Source: Tokwe and Schafer (2009)*

It was noted that when giving instructions both educators preferred speaking in isiXhosa, but when they began explaining mathematical concepts and terms, use of the English language and the practice of code-switching increased.

After the Concept Literacy Resource book was used, it was found that the use of isiXhosa increased when asking questions, expressing themselves and explaining important concepts. The use of the mother tongue increased

and educators appeared more confident in using isiXhosa to explain mathematical concepts.

*Figure 4: The Code-Switching Practices of Educators Y and Z After the Concept Literacy Resource Book Had Been Used Over Two Terms*



Source: Tokwe and Schafer (2009)

Research into the use of the Concept Literacy Resource book shows that it played an important role in promoting the use of indigenous languages in the teaching and learning of mathematics in South Africa, however the resource book did have some shortcomings. Many educators and learners using the isiXhosa resource book found that the isiXhosa used in the book was sometimes difficult to understand (Schafer, 2005). The book used traditional isiXhosa whilst the educators and learners used modern ‘township’ isiXhosa. Most educators agreed that the entire book needed to be translated into isiXhosa instead of the key concepts only. Also many educators felt it was important to teach through the medium of isiXhosa in order to preserve the language, however, there was resistance by some learners and parents who felt that they should learn mathematics through the medium of English since English is the international and dominant language (Schafer, 2005).

### 2.11.2.2 Teaching Language Skills in South Africa

Uys *et al.* (2007: 69) found that subject content educators are not teaching language skills to ESL learners and this may be a possible reason why

learners are not achieving academically. Some of the educators interviewed felt that the teaching of language skills was not their responsibility but the responsibility of the educators of English. They also felt that if valuable instruction time is spent on teaching language skills, then they would not have time to complete the syllabus (2007: 74). The educators also mentioned that they did not receive training required for effective English medium of instruction (2007: 78). Uys *et al.* (2007: 78) therefore suggest that teacher training institutions design appropriate training courses that will prepare subject content educators for multilingual classrooms.

### *2.11.2.3 Collaborative Co-Teaching in South Africa*

Kruger and Yorke conducted studies into the use of collaborative co-teaching of numeracy and literacy as a means of addressing learners' diverse needs (2010: 293). Collaborative co-teaching requires the learning support educator and the class educator to work together as partners in all aspects of instruction. Kruger and Yorke (2010: 304) found that learners recognised the benefits of having two educators in the classroom as they received help from two interested educators. They added that learning support educators can play an important role in helping second language learners to overcome their language difficulties in the mathematics classroom.

The final section of this chapter provides the framework which grounds the teaching and learning of word problems in mathematics, and discusses its implications for the teaching of mathematics to ESL learners.

## **2.12 THEORETICAL FRAMEWORK**

A theoretical framework is a model of how the researcher makes logical sense of the relationships among the factors that have been identified as important to the research problem (Sekaran, 2000). The theoretical framework used to underpin this study is the Constructivist Learning Theory. Before pointing out the implications of the constructivist learning theory for this study, constructivism will be discussed.

### **2.12.1 Constructivism**

According to Sridevi and Gohit (2008: 9), behaviourism, which associates learning to response strengthening whereby the learner is repeatedly cued to give a simple response followed by immediate feedback and passive acceptance of rewards and punishment, is simply becoming irrelevant. They add that cognitivism, which associates learning to knowledge acquisition and considers information as a commodity that can be transmitted directly from teacher to learner, retains some relevance but is not enough. Constructivism which associates learning to the building of one's own knowledge is much more appropriate to today's situation, in that it views learning in the perspective of the learner. The teacher is considered as a cognitive guide while the learner is empowered to construct his own meaning and not just memorize the right answers.

Kintsch (2009: 234) maintains that constructivism is a theory of comprehension and learning, that focuses on the active process of constructing meaning and building knowledge. Sheridan (2008) adds that constructivism is a descriptive theory of knowledge which asserts that what we know is based on the ideas we invent. We construct our own understanding based on our pre-existing knowledge as well as the ideas we come into contact with (Sridevi and Gohit, 2008).

Lev Vygotsky, the renowned Russian psychologist, is regarded as the scholar who has most influenced social constructivist epistemology. In contrast to the behaviourists who view learning development in the light of the individual's passive responses to the environment, Vygotsky views learning development within the framework of the individual's social interactions (Nakata, 2006: 113). Social constructivism, a branch of constructivism, focuses on the interactions between human beings (Sriraman, 2006). Learners in their daily interactions are influenced by their educators, parents, friends and society, in general (Sridevi and Gohit, 2008). Social constructivists believe that people bring different experiences to a



situation and this influences their perceptions of that situation (Lodico, Spaulding and Voegtle, 2010). This implies that in the school situation, educators could help learners to use their experiences to build knowledge.

### **2.12.2 The Constructivist Learning Theory**

Piaget's theory of constructivist learning has had wide ranging impact on learning theories and teaching methods (Wertsch, 1997). A major theme in the constructivist learning theory is that learning is an active process in which learners form new ideas based on their current and past knowledge (Bruner, 1966). He explains the constructivist learning theory as a general framework where instruction:

- must be concerned with concepts that motivate learners to learn;
- must be structured in such a way that it is easily understood by learners;
- should be designed to aid extrapolation and filling in the gaps; and
- should involve the use of rewards and punishment.

The constructivist learning theory involves the use of constructivist teaching techniques. Unlike conventional classrooms where educators serve as pipelines transferring their thoughts to passive students, constructivism is a view of learning based on the belief that knowledge cannot be simply given by the teacher at the front of the room to students in their desks (Sridevi and Gohit, 2008: 30). Instead, in a constructivist classroom, learners are actively involved, activities are interactive and learner-centred, the environment is democratic and the educator facilitates learning (Gray, 1997). Learners participate in groupwork and class discussions, thereby promoting exchange of ideas, as well as social and communication skills (Jonassen, 1997). Piaget, in researching childhood development and education, maintained that children are not blank slates, they learn best when they are allowed to experience things and reflect on their experiences rather than when they receive knowledge passively (Von Glasersfeld, 1989). Since learners' existing knowledge is the starting point for new knowledge, the constructivist

approach acknowledges individual and cultural differences and diversity. The educator leads the process through questions and activities that encourage learners to discover, discuss, appreciate and verbalise new knowledge (Bauersfeld, 1995). Constructivist teaching assessment is not based solely on tests, but on the observation of the learner, the learner's work and the learner's point of view.

Whereas Piaget focused on children's understanding of their physical environment, Vygotsky was concerned primarily with how children understand their social world (Nevid, 2007: 374). He believed that cultural learning is acquired through a gradual process of social interactions between children and parents, educators, and other members of the culture and these interactions provide them with knowledge they need to solve everyday challenges. Also, while Piaget maintained that language development is closely related to the child's stage of development, Vygotsky believed that language develops as a result of social interactions with others (Jarvis, 2000: 113). Vygotsky observed the performance of children who worked independently as compared to those who were coached (Carr, 2004: 16), and found that optimal learning will only take place when the parent, educator or peer takes cognisance of the child's ability level.

According to Jarvis (2000: 112) children learn concepts on their own during everyday experiences, but they could develop far more during interactions with others. Vygotsky called the difference between what the child can understand on his own and what he could potentially learn through interaction with others the zone of proximal development (Jarvis, 2005: 28). Vygotsky's zone of proximal development distinguishes between three levels of knowledge: the first level refers to tasks the learner can perform without assistance from the educator; the middle level involves tasks that the learner does not fully understand but may be able to accomplish with assistance from the educator; while the highest level refers to tasks that are beyond the learner's ability (Foote, Vermette and Battaglia, 2001). The middle level is

called the zone of proximal development since learners learn best in this level. By experiencing successful completion of the tasks, learners gain confidence and motivation to embark on more complex challenges (Prawat and Floden, 1994). Closely linked to this concept is that of scaffolding, a term coined by Wood, Bruner and Ross to describe the kinds of support learners need to reach their zone of proximal development (Robson, 2006: 31).

Scaffolding is the process of adjusting instruction so that it is responsive to a beginner's behaviour and supports the beginner's efforts to understand a problem or gain a mental skill (Coon and Mitterer, 2007: 114). Bruner had initially intended 'scaffolding' to apply to strategies parents employ to facilitate the acquisition of language, but later conceded that educators can use scaffolding to develop communication and language and to provide support in the teaching of content. Scaffolding in the classroom situation involves helpful and structured interaction between the educator and the learner, in order to help the learner achieve educational goals (Lambert and Clyde, 2003: 75).

Bruner explains that the key role of the educator is to provide structures for learning that will enable the learner to progress from the immediate information and generate new ideas and ways of understanding the world (Lilley, 1997: 92). According to Mundy and Siegman (2006: 306), the adult partner will have to modify instructional tasks according to the child's abilities and "zone of proximal development" to enable the child to reach successful completion of the tasks. The assistance that the adult provides to the child is reduced as the child gains independence (Davis and Miyake, 2004: 308). The purpose of scaffolding is twofold: to allow educators to control those components of the task that are beyond the child's ability level, and at the same time to allow learners to control their own efforts (Cappello and Moss, 2009: 182). Repetition of these types of guided interactions between educator and learner will provide learners with skills to work independently in future tasks.

### **2.12.3 Implications of the Constructivist Learning Theory for this Study**

A central issue in mathematics education is how teachers can help learners to construct knowledge (Lampert, 1990). Leon Streefland, a prominent researcher on the influence of collaborative teaching on the construction of knowledge, conducted research on learning through interaction and collaboration (Elbers, 2003). He believed in childrens' talents and was of the view that creating a learning environment conducive to discussion and active participation would allow their creative abilities to grow (Elbers, 2003). He found that interaction and collaborative learning stimulates children to construct mathematical meaning and to discuss them through reflection. Constructivist teaching techniques such as creating an atmosphere of mutual trust and co-operation was essential so that children felt free to voice their ideas and make valuable contributions to the lesson. It was found that in this environment even the least talented children were encouraged to participate in the process of constructing mathematical meanings (Bay-Williams and McGraw, 2008: 130).

Another technique that Streefland used was planning his lessons around problems that were relevant and meaningful for the learners, and he often referred to learners' real-life experiences in his teaching (Elbers and Streefland, 2000). In the teaching of mathematics it is necessary to understand the connection between mathematics and the learners who are trying to learn mathematics (Anhalt, Ondrus and Horak, 2007). This makes it possible for students to understand the problem, to ask questions, to answer them, to produce mathematical arguments and to substantiate their views. When mathematics is taught in this way it helps students to connect their everyday knowledge and mathematics and to make sense of mathematical concepts (Elbers, 2003).

Teaching of mathematics word problems to ESL learners using the constructivist learning theory involves choosing real life scenarios that are relevant to the child's experiences. It involves problem-solving tasks that are

enjoyable, realistic and relevant to the learners' background, culture and experiences (Kruger and Yorke, 2010: 296; Jonassen, 1997; Wertsch, 1997). ESL learners are given a chance to discuss the problem and solution strategies with their peers in groups (Hein, 1991). When learners participate actively in groups and classroom discussions, they are encouraged to verbalise their thoughts and exchange ideas. Learners with different skills and backgrounds collaborate on tasks and discussions in order to arrive at a shared understanding of the truth (Jonassen, 1997; Van der Walt and Maree, 2007: 224). Any misunderstanding of the word problem due to the language barrier can be easily identified by the educator or other learners, and explained to the learner.

Vygotsky argued that children's learning is most affected by their mastery of language, he argued further that children learn the most about language from their interactions with people (Tracey and Morrow, 2006: 109). He proposed that the constructivist learning environment involve guided interactions by mature and knowledgeable adults (Sridevi and Gohit, 2008) who allow learners to reflect on their mistakes or areas of difficulty and to change their thinking through communication. The responsibility of the mathematics educator then, is to steer the direction of problem-solving towards the construction and communication of new ideas. In the constructivist classroom educators can help by respecting ESL learners' current language skills and by encouraging them to express their ideas and experiences. When learners connect ideas and create new ones, they have greater ownership of the learning process (NCTM, 2007). They are therefore most productive since they are now working in the zone of proximal development (Garcia, 2003: 98).

As the facilitator, the mathematics educator must communicate to second language learners that their ideas are valuable and useful for the progress of the lesson. Even when their answers are incorrect, learners must be corrected and encouraged to try again. Kruger and Yorke (2010: 302) recommend the use of new and different learning support activities that make

learning fun and provide opportunities for the weak learners to succeed in the classroom. Educators are expected to simplify tasks and use smaller steps which will eventually lead learners to the final answer. As mentioned earlier, Bruner (1973) encourages the use of these scaffolding methods to aid learners in language development and understanding of content matter. Then, as the confidence levels of learners increase the educator could move on to more complex tasks.

### **2.13 SUMMARY**

In reviewing literature pertinent to this study, this chapter briefly described the education system in South Africa, the LiEP and the reasons for African parents choosing to admit their children at English-medium schools. A large percentage of these learners are subsequently experiencing difficulty learning through the medium of English. Reference was made to South African learners' poor performance in international mathematics and literacy tests, and the fact that poor proficiency in the English language has led to learners performing poorly in mathematics.

The chapter proceeded to outline the initiatives undertaken both in South Africa and internationally to address the challenges that ESL learners experience in learning mathematics.

Chapter three presents the research design and the research methodology used in this study. The data collection instruments are discussed and the sample, design and sampling method techniques are described.

## **CHAPTER THREE**

### **RESEARCH DESIGN AND METHODOLOGY**

#### **3.1 INTRODUCTION**

The previous chapter examined the link between language and mathematics and outlined local and international initiatives being undertaken to help second language learners learn mathematics through the medium of English. Chapter three outlines the research aims and design before discussing the approach used to conduct the research. This is followed by a detailed explanation of the sampling process, and the research instruments used for the collection of data. The chapter ends with a discussion of the ethical considerations of this study, data analyses, and the tests for reliability and validity.

#### **3.2 RESEARCH AIMS, OBJECTIVES AND DESIGN**

The aim of this study was to investigate the challenges that mathematics educators and ESL learners experience in the teaching and learning of word problems through the medium of English, and to determine whether educators are adapting their teaching strategies when teaching ESL learners.

In order to achieve the above aim, the following objectives were addressed in this study:

- to identify ways in which ESL learners learn mathematics with special emphasis on word problems;
- to identify strategies that mathematics educators use to teach word problems to ESL learners; and
- to identify challenges that mathematics educators and ESL learners encounter in the teaching and learning of word problems.

The purpose of undertaking research is to find answers to the research questions in an orderly and objective manner (Payton, 1979: 4). According to Green and Tull (1970), a research design aids in this process by specifying the methods and procedures that will be used to collect the information needed. The research design is therefore a strategy that outlines what information will be collected, where the information will be collected from, and what procedures will be used to collect the information (Trochim and Land, 1982).

Since this study focuses on the learning difficulties of ESL learners, descriptive research was used to provide useful information related to second language development. Seliger and Shohamy (2000: 129) explain that descriptive research is useful for providing a picture of factors connected with second language development. They add that these descriptions may provide a basis for making important universal inferences about second language acquisition for a wider population from the same language, background, age, or educational level.

Two common descriptive research designs are: observational research and survey research (Mertler, 2006: 71). In this study a descriptive survey research design was used, which according to Cresswell (2002) describes and explains conditions of the present by using subjects and questionnaires to fully describe a phenomenon. Although surveys can be used in different research designs, most often surveys are conducted to obtain a description of a particular group of people (Gravetter and Forzano, 2008: 361) and to record the nature and frequency of a particular variable within that group (Heppner, Wampold and Kivlighan, 2008: 226). In this study, survey research was used to investigate mathematics educators' experiences with ESL learners, and the teaching strategies they use in teaching ESL learners.

The approach a researcher uses to conduct the research is called research methodology (Kumar, 2005: 16).



### **3.3 RESEARCH METHODOLOGY**

Research methodology refers to the selection of the research questions, the theoretical framework and the research methods (Cresswell, 2002). The data collection strategy used in a research study is determined by the research question and data sources, and researchers are encouraged to use more than one method of data collection in order to increase the validity of their results (Merriam, 1998). In this study the research approach used was a mixed methods approach.

#### **3.3.1 Mixed methods approach**

When both quantitative and qualitative research is undertaken in the same study, this is termed a mixed methods approach (Cresswell, 2002). The use of a mixed methods approach provides a better understanding of the research problems and is likely to increase the quality of the final results (Creswell and Plano Clark, 2007). Quantitative research tends to involve relatively large-scale and representative sets of data, and is often presented or perceived as being about the gathering of 'fact' (Blaxter, Hughes and Tight, 2006: 64).

According to McMillan and Schumacher (2001: 395), qualitative research is an inquiry in which researchers collect data in face-to-face situations by interacting with selected persons in their natural settings. The data are descriptions and observations and the researcher uses words to describe the phenomena being investigated (Ploeg, 1999). Blaxter *et al.* (2006: 64) add that qualitative research is concerned with collecting and analysing information in as many forms, chiefly non-numeric, as possible. It tends to focus on exploring, in as much detail as possible, smaller numbers of instances or examples which are seen as being interesting or illuminating, and aims to achieve 'depth' rather than 'breadth.'

In qualitative research the researcher expands his/her understanding of the situation by means of verbal and non-verbal communication and through accurate interpretations of participants' responses (Patton, 1989). Qualitative data obtained through interviews and observations are analysed according to themes and patterns (Patton, 2002). Quantitative research, on the other hand, is an inquiry into a social problem (Cresswell, 1998) and attempts to provide an accurate picture of a particular situation (Christensen, 2001). The data are presented in the form of numbers and measurements, and are analysed by means of statistical procedures (Cresswell, 1998). Quantitative researchers are interested in the development and testing of hypotheses, as well as the generation of theories that explain behaviours (Hoy, 2009: 1).

In this study qualitative research was conducted by means of focus group interviews with learners, and quantitative research was carried out through the administering of questionnaires to educators. These instruments will be discussed in detail later in this chapter.

Before explaining the data collection methods that were used in this study, it is important to discuss the target population and the sampling technique that was used, as well as the administrative procedures that were adhered to before conducting research at the selected schools.

### **3.4 THE SAMPLING APPROACH**

Sampling is a procedure that uses a small number of elements of a population as a basis for drawing conclusions about the whole population (Neelankavil, 2007: 240). Since it is impossible to take a survey of the entire population, a sample is used, which is then followed by statistical techniques to make inferences from the sample back to the population (Bernstein and Bernstein, 1998: 61). The steps involved in developing a sample are to: define the target population; obtain a list of the population; select a sample frame; determine the sample methods; develop a procedure for selecting the

sample units; determine the sample size; and draw the sample (Neelankavil, 2007: 234).

### **3.4.1 The Target Population**

According to Bui and Taira (2009: 412) the target population is a microcosm of the real world and all its components have some common characteristics. The researcher chose to carry out her study in the Mafukuzela-Gandhi education circuit as she is a mathematics educator working in this circuit, and she is aware of the challenges grade 8 ESL learners experience in the learning of mathematics.

The Mafukuzela-Gandhi circuit was launched on the 24<sup>th</sup> July 2007 as a result of the KwaZulu-Natal Department of Education bringing together two education circuits: the KwaMashu circuit which serves a predominantly African area comprising of Inanda, Ntuzuma and KwaMashu; and the Phoenix circuit which serves a predominantly Indian area comprising of Phoenix, Verulam and Tongaat (Chetty, 2007). Some of the challenges experienced by learners living in the abovementioned areas are poor housing, extreme poverty and the absence of parents from homes. These factors can result in reduced attention span, lack of ability to plan or think with insight, retarded development of language and behavioural problems in class (Coutts, 1992). Schooling is therefore challenged to overcome the lack of language and thinking skills that might result.

After defining the target population, the researcher has to compile a list of all the elements from which the sample may be drawn (Neelankavil, 2007: 240). This is called the sampling frame. In this study the sampling frame comprised the 81 secondary schools in the Mafukuzela-Gandhi circuit. After determining the sample frame, the researcher proceeded to select a sampling method to draw the sample.

### **3.4.2. The Sampling Frame and Method**

If the sample is representative of the target population, then it is reasonable to use the results from the sample to make generalizations about the population (Castillo, 2009). The safest way to ensure that the sample of schools is representative of the population, is to use a random selection procedure because as Hopkins (2000) explains, when simple random sampling technique is used, each member of the total population has an equal chance of being selected as a participant. The simple random selection technique was used to draw a sample of schools in this study.

One of the forms of random sampling is picking names out of a hat. Fowler (2002: 14) explains that when drawing a sample out of a hat, members of a population are selected one at a time, independent of one another and without replacement; once a unit is selected, it has no further chance to be selected. For the purposes of this study, the researcher printed the names of the 81 secondary schools in the Mafukuzela-Gandhi Circuit on a sheet of paper. These names were then cut out, tightly folded, put into a hat and mixed thoroughly. The blindfolded researcher pulled out the names of the first ten schools which then formed the sample (Castillo, 2009).

To determine the sample size, Babbie's (2001: 211) sampling table was used where everyone in the population was numbered; thereafter a table of random numbers was used to select a sample from the population. Members whose numbers were chosen made up the sample. According to Babbie, a sampling ratio of 1:10 may be used. The sampling ratio is defined as the proportion of elements in a population that are selected to form a sample and the corresponding formula to calculate sampling ratio is:

Sampling ratio = sample size divided by population size (Babbie, 2001: 213).

As the target population in this study was the 81 secondary schools in the Mafukuzela-Gandhi Circuit, using the sampling ratio of 1:10 resulted in a sample size of eight schools. The researcher decided to use ten schools and

20 educators, that is two educators per school, since each school had an average of two to three grade 8 mathematics educators.

When the researcher took the questionnaires to the selected schools, she asked the principals or heads of the mathematics departments to select two educators, currently teaching grade 8 mathematics to complete the questionnaire, that is, a 'seasoned educator' and a 'young educator'. For the purposes of this study a 'seasoned educator' was defined as an educator with more than ten years of teaching experience, and a 'young educator' was defined as an educator with less than ten years of teaching experience.

For the selection of learners for the focus group interviews, the researcher again used a sampling ratio of 1:10 as suggested by Babbie (2001: 213). Since most grade 8 classes had an average of 40 learners, the researcher chose four learners per school making up a sample of 40 learners. The task of selecting participants for the focus group interviews was left entirely to the educators since they know their learners. Educators were asked to choose learners with a mix of abilities that is, to select one 'high' achieving learner who on average scored above 80% in assessments, one 'weak' learner who on average scored below 40% in assessments and two 'average' learners who regularly scored between 40% and 70% in mathematics. The researcher requested a 'good mix' of learners in order to extract rich, honest and meaningful responses from them. Learners had to be willing to participate in the focus group interview.

### **3.5 DATA COLLECTION INSTRUMENTS**

#### **3.5.1 Primary and Secondary Sources**

Data obtained from different sources are used by researchers to understand what happens in the classroom (Ferrance, 2000) and to provide the best answers to the research question (Merriam, 1998). Primary sources are obtained by the researcher who has conducted the study (Saracho, 2006) and usually takes the form of surveys and interviews. Secondary sources

identify and gather information from primary sources (Ferrance, 2000) and are usually found in journals, literature reviews, books and internet sites. In this study primary data was collected from focus group interviews with learners, and questionnaires that were administered to educators. Both instruments were pilot tested by the researcher before being used at the selected schools.

### **3.5.2 The Pilot Study**

The educator questionnaire and learner focus group interview schedule were pilot tested at the school at which the researcher is currently teaching. The purpose of a pilot test is to refine the questions on the questionnaire to ensure there is no ambiguity so that the measuring instrument is fine tuned for data collection (Dillman, 2000; Oppenheim, 1992: 64). For the purposes of this study, educators and learners from the school in which the researcher is currently teaching were randomly selected to test the educator questionnaire and learner interview schedule so that the necessary adjustments could be made before the questionnaire was administered to the research sample. The pilot study, which was conducted among two educators and four learners, revealed that learners were unable to answer some questions on the focus group interview schedule since the language used in the questions were difficult for them to understand. The researcher simplified the language to make the questions understandable to the learners. Also, at the start of the interview learners appeared to be nervous and afraid that the information they provided would be disclosed to their educators. The researcher realised that she would have to make use of incentives such as sweets and icebreakers, and that she needed to reassure them that the information they provided would be kept strictly confidential.

The pilot testing of the questionnaire revealed that some open-ended questions did not have sufficient space for educators' responses. The researcher then went back to the questionnaire and increased the space provided for responses. After the research instruments were pilot tested, the

researcher visited the selected schools to explain to the principals the purpose of the study. The questionnaires were then handed out to the educators and arrangements were made as to when the researcher would return to conduct focus group interviews with the learners.

### **3.5.3. Collecting Data through Focus Group Interviews**

The qualitative data for this study were obtained through focus group interviews with learners. The primary aim of a focus group is to describe and understand meanings and interpretations of a select group of people to gain an understanding of a specific issue from the perspective of the participants of the group (Liamputtong, 2011: 3). Struwig and Stead (2001: 99) add that a focus group interview is a group discussion designed to explore topics where little information is known or where respondents' views about a topic need to be obtained. Brewerton and Millward (2001: 80) state further that it involves the simultaneous use of multiple respondents to generate data, and the 'focused' (ie. on an external stimulus) and relatively staged (ie. by a moderator) nature of the focus group method separates it from other types of group interviewing strategies.

Focus group interviews in an informal setting allow participants to discuss issues in a relaxed and comfortable environment (Michie and Abraham, 2004: 133). In the school setting, focus group interviews provide a safety net for learners since they are more relaxed in the company of fellow learners and are freely able to discuss a topic in great detail (Gubrium and Holstein, 2003: 35). The focus group size can range from four to twelve (Krueger and Casey, 2000: 10). Liamputtong (2011: 42) suggest that smaller groups are preferable since they allow participants to speak freely and to explore issues thoroughly, thereby resulting in rich and relevant information. In this study each of the focus groups comprised four to five learners. The researcher found that she was able to explore issues thoroughly with a small group. Furthermore the school principals were not in favour of releasing too many learners from their classes during tuition time.

The researcher found that focus group interviews in the school setting allowed ESL learners an opportunity to talk about their experiences in learning mathematics, and the challenges they encountered in learning mathematics through a second language. As Wilkinson and Birmingham (2003: 43) said, it is easier to interview learners with limited literacy skills rather than to get them to complete questionnaires. An interview schedule containing questions for the focus group interview was used to conduct semi-structured discussions with groups of four to five Grade 8 learners per school.

#### *3.5.3.1 The layout of the focus group interview schedule*

According to Lindlof and Taylor (2010: 199) an interview schedule is used when a project requires uniformity in the wording and sequencing of questions. They add that the overarching goal is to ensure that everyone in the sample understands the same questions in the same way (although there may be different sets of questions asked of different respondents depending on how certain “qualifying” questions are answered).

In this study the learner Focus Group Interview Schedule (*Appendix B*) consisted of a list of questions to be used and was accompanied by a covering letter and consent form (*Appendix E*). The covering letter explained to the learners the purpose of the research study and assured them that the information they provided would not be divulged to their educators or principal or anyone other than the researcher’s supervisor. The learners were expected to sign a consent form to signify that they were informed of the purpose of the study and that they had agreed to participate in the interview. Learners were also asked to give consent for the audio-recording of the interviews. The remainder of the interview schedule comprised semi-structured questions that the interviewer would use in the focus group interview. According to Lodico, Spaulding and Voegtle (2010) semi-structured interviews are carefully planned before being carried out and the researcher develops an interview schedule that comprises questions that will be



addressed. Questions are predetermined and allow the interviewee flexibility to vary the order and wording of the interview questions (Wilkinson and Birmingham, 2003: 45). The semi-structured format provides large amounts of useful information (Leedy and Ormrod, 2009) in the respondent's own words even when the questions are complex or when the interview is long (Mathers, Fox and Hunn, 2002), allowing the researcher to probe into their responses, clarify answers and ask follow-up questions (Stewart, Shamdasani and Rook, 2007).

As recommended by Krueger and Casey (2000: 44) the following five categories of questions were used for the interviews:

- opening questions which helped to relax the participants and to get them to start talking;
- introductory questions which introduced the topic and encouraged discussion amongst participants;
- transition questions which delved into the key concepts;
- key questions which formed the crux of the interview and required a lengthy and in-depth discussion of the topic; and
- ending questions which brought the discussion to an end.

When conducting focus group interviews the interviewer plays a vital role in guiding the discussion process.

### *3.5.3.2 The role of the interviewer*

According to Harris (2010), the role of the interviewer is to ask the questions and to ensure that all interviewees participate in the discussion. Vega and Aramburuzabala (2008: 35) add that when working with children, the interviewer has to motivate them, maintain their interest, and ensure that the interview proceeds in an interesting and pleasant manner. The interviewer is expected to listen carefully to the participants' responses (Kreuger and

Casey, 2000: 4) and think of follow-up questions at the same time (Kreuger, 1988: 75) in order to probe and delve deeper into complex topics (Wilson, 2010: 46). The researcher took all of the above information into account when conducting the interviews.

#### *3.5.3.3 Conducting the focus group interview*

As mentioned earlier, the researcher made prior arrangements with the principal and educators of the ten selected schools to conduct interviews with learners. The interviews were scheduled early in the morning or during lunch breaks, to prevent disruptions during tuition time. When the researcher arrived at the school, the mathematics educators assisted in forming the focus groups with their pre-selected ESL learners of varying mathematical ability.

In two schools, the principal allowed the researcher the use of the boardroom to conduct interviews. The researcher asked learners to sit together around the table to allow her better control of the discussion process. In the other four schools the researcher was allowed the use of a classroom. The researcher asked learners to arrange their chairs in a circular pattern. Learners were informed that the interview would be recorded by means of a dictaphone, to allow the researcher to listen to and analyse the data at a later stage. Their permission was sought before commencing with the interviews. None of the learners objected to the recording of the focus group interviews.

An ice-breaker was used to ease learners into the interview process. Stewart and Shamdasani (1990) recommend the use of ice-breakers to reduce nervousness and to build rapport with the group. The interviewer briefly explained the purpose of the interview and pointed out ground rules to be followed during the interview process, she then proceeded to ask questions from the interview schedule. The questions were semi-structured and open-ended allowing learners to freely express their views and talk about their experiences in the mathematics classroom. There was no particular order in

which learners were called upon to answer questions. Since the interview took the form of an informal discussion, learners were encouraged to add any information they felt was relevant to the discussion. The researcher made use of probing and follow-up questions to gain greater insight into learners' experiences and responses. During the focus group interview the researcher found that some participants were quiet and reserved and were not participating in the discussion. The researcher then began directing questions to those learners in order to increase their confidence and to draw them into the discussion. There were also outspoken learners who began to dominate the group discussion. To address this problem the researcher very cautiously limited their responses and the questions directed to them, in order to give the other participants an opportunity to contribute. Each focus group interview lasted about one hour in duration.

Quantitative data in this study was collected by administering questionnaires (*Appendix C*) to educators at the selected schools.

### **3.5.4 Collecting Primary Data through Questionnaires**

A survey involves the use of questionnaires or interviews in order to generalize results from the sample to a population (Cresswell, 2002). Questionnaires are written instruments that require respondents to write out their answers to a set of questions (Dornyei, 2003). Administering questionnaires to a representative sample of a population is a useful method of collecting information (Christensen, 2001; McMillan and Schumacher, 2001).

#### *3.5.4.1 Administration of the questionnaires*

According to Balnaves and Caputi (2001: 84), administration of the questionnaire involves: layout; decisions on length of questions; types of questions to be asked; implementing the survey; monitoring the quality of answers; response rates; poor quality responses; and poor data generally. They add that the questionnaire is also an 'ambassador' for the research

project. Cohen, Manion, Morrison and Morrison (2007: 344) distinguish between two types of self-administered questionnaires: those that are completed in the presence of the researcher, and those that are completed without the presence of the researcher. In this study the respondents were allowed to fill in the questionnaires at their leisure in the absence of the researcher. After the questionnaire had been pilot tested, they were handed out to two educators at each of the selected schools. The researcher visited the selected schools and handed out the questionnaires to the educators during her non-teaching periods and lunch breaks. According to Wallen and Fraenkel (2001) the questionnaire allows respondents time to read through the questions and give thought to their answers. The researcher asked the educators to answer the questionnaire honestly and to return the completed questionnaires to the forwarding address given on the covering letter or to inform her telephonically so that she could make arrangements to pick them up. A covering letter and consent form (*Appendix D*) was attached to the questionnaire informing educators of the purpose of the research study and assuring them of their anonymity and confidentiality. Educators were asked to complete and sign the consent form.

#### *3.5.4.2 Layout of the Questionnaire*

The appearance of the questionnaire is vitally important. It must look easy, attractive and interesting rather than complicated, unclear, forbidding and boring (Cohen, Manion, Morrison and Morrison, 2007: 338). The researcher used the layout as suggested by Balnaves and Caputi (2001: 84), namely:

- a general introduction explaining the purpose of the questionnaire and assuring respondents of confidentiality and anonymity;
- instructions informing respondents about how questions were to be answered; and
- the order of questions beginning with the simpler questions and progressing to the complex questions.

Two considerations are critical in the layout and design of questionnaires: ease of use for the respondent, and ease of use for data processing (Anderson and Morgan, 2008: 117). The questionnaire should be designed as simply as possible in order to encourage participation by all respondents (OECD, 2003: 13). The researcher followed Anderson and Morgan's (2008: 117) list of characteristics of a good questionnaire as follows: questions were presented in a simple and uncluttered manner; headings, fonts and the layout were kept consistent; the response categories were associated with each question and coded for data analysis. She heeded Tubke's (2005: 89) advice and ensured that the questions were numbered correctly to improve clarity, and sufficient space was provided for responses.

The sequence of questions followed Basit's (2010: 85) recommendations which advocate that questions which are straightforward and of a factual or biographical nature can be easily answered and are therefore placed at the beginning. He explained that this makes the respondent confident and interested in proceeding to complete the rest of the questionnaire.

#### *3.5.4.3 Questionnaire Design*

A good questionnaire moves from objective facts to subjective attitudes and opinions and allows you to obtain justifications for answers to open questions and to sensitive, personalised data (Lowe, 2006: 53). According to Babbie (2001: 148) questions may be divided into open-ended questions or closed questions. Open-ended questions allow respondents to freely give their responses and to give a variety of responses (Sekeran and Bougie, 2009). Closed questions on the other hand, direct the respondents to certain options and allow the researcher to learn about participants' behaviours, attitudes and opinions (Cooper and Schindler, 2007). It is common for researchers to start with the factual questions, then proceed to closed questions about given statements or questions, and end with open-ended questions that elicit reasons for given responses (Lowe, 2006: 53). Open-ended questions therefore seek a spontaneous and unprompted response while closed

questions limit the respondent to a predictable set of answers (Brace, 2008). The closed questions used in the questionnaire provided educators a list of responses to choose from, whilst the open-ended questions allowed educators to express their views and talk about their experiences with ESL learners.

In this study, the questionnaire comprised the following 4 sections:

Section A: Biographical data of the educator – in this section, educators had to answer closed questions regarding their age, gender, teaching experience and languages they speak.

Section B: Demographics of the school – this section also comprised closed questions regarding the composition of their mathematics classes and learners' proficiency in English.

Section C: Mathematics and language – here educators were asked to describe ESL learners' performance in mathematics and to comment on the need to adapt their teaching strategies when teaching these learners.

Section D: Curriculum – this section questioned whether the present grade 8 mathematics curriculum caters for the language needs of ESL learners, and asked educators to add additional comments on their experiences with ESL learners.

In sections C and D the researcher made use of closed and open-ended questions to collect data about educators' experiences in teaching word problems to their learners and to determine whether and how they were adapting their teaching strategies to help ESL learners solve word problems.

#### *3.5.4.3.1 Closed Questions*

The main feature of closed or restricted questions is that respondents are expected to choose from a limited number of response alternatives (Ruane, 2005). The researcher provides a list of possible responses and the

respondent selects the most appropriate response (Friesen, 2010). In this study closed questions were used mainly in Sections A and B, which focused on educators' biographical details and demographics of their schools.

#### *3.5.4.3.2 Open-ended questions*

Open-ended questions introduce a topic and then allow respondents to answer these questions in their own words, thereby encouraging flexibility and imposing fewer restrictions on the participants (Gravetter and Forzano, 2008: 362). Ruane (2005) recommends the use of open-ended questions when investigating a complex topic, and when eliciting respondents' views on this topic. The researcher used open-ended questions mostly in Sections C and D, to get educators to describe their experiences with ESL learners and to investigate strategies they use to overcome challenges in the ESL classroom.

In all interactions with learners and educators the researcher has to ensure that he or she protects the rights of the participants. The ethical considerations of this study are now discussed.

### **3.6 ETHICAL CONSIDERATIONS**

What we consider as moral and ethical in day-to-day life is a matter of agreement among members of a group in a particular society (Babbie, 2008: 67). Similarly anyone involved in research, needs to be aware of the general agreements shared by researchers about what is proper and improper in the conduct of scientific inquiry

When conducting research, the researcher has an obligation to the participants to protect their rights to informed consent, anonymity and confidentiality. The researcher has to ensure that the participants participate voluntarily after being briefed on the research procedure (Heffernan, 2005: 108). In this study the researcher clearly explained the purpose of the study and the research procedure to the learners and educators before asking

them to sign the relevant consent forms (*Appendices D and E*). Participants had voluntarily agreed to participate in the research study and were given the option to withdraw at any time. Apart from informed consent, participants also had the right to anonymity and confidentiality. As Greenstein (2006: 167) explains, anonymity means that no identifying information should be retained in the researcher's files following completion of data collection. The learner and educator participants were requested to sign the relevant consent forms signifying their willingness to participate in this study.

A research study upholds confidentiality when the researcher can identify a participant's response but promises not to do this (Babbie, 2010: 67). In this study the researcher agreed to keep information confidential by not divulging the participants' identity when reporting the collected data. With respect to the focus groups, learners' names were not divulged during the reporting of data. The participants' right to anonymity was respected by asking educators not to indicate their names on the questionnaires. Pseudonyms are normally used by researchers in the write-up and reporting of data to maintain the anonymity and confidentiality of the participants.

Before commencing with this research study, the researcher obtained written permission (*Appendix A*) from the KwaZulu-Natal Department of Education and Culture District office in Pietermaritzburg as well as the principals and educators of the selected schools. Ethical clearance was obtained from the Durban University of Technology for the educator questionnaire and the focus group interview schedule.

### **3.7 LIMITATIONS OF DATA COLLECTION INSTRUMENTS**

#### **3.7.1 Limitations of the educator questionnaire**

The questionnaire is a convenient and inexpensive data collection instrument (Kumar, 2005: 130) but it does have limitations. The limitations of the questionnaire that applied to this study are now discussed.



#### *3.7.1.1 Written responses*

The researcher found that while a small percentage of respondents had answered questions honestly and given much thought to their answers, others rushed through the questionnaire giving very short answers to the open-ended questions sometimes leaving questions unanswered. After consulting with her supervisor, the researcher conducted semi-structured interviews only with those educators who had not answered the questionnaires well enough. The researcher made arrangements to return to those schools and meet the educators concerned in order to complete those sections that were either unanswered, partially answered or where insufficient answers were provided. The researcher therefore followed a standardized set of questions but at the same time probed for additional information (see Thomas, 2009: 223) where the respondent did not answer the question fully.

#### *3.7.1.2 Time*

The researcher had handed out the teacher questionnaires two weeks before the public servants' strike, regarding educators' salaries and working conditions, began. The strike involved schools throughout KwaZulu-Natal and therefore also affected the Mafukuzela-Gandhi circuit. As a result schools were closed and the majority of educators were involved in protest action and mass stayaways. While some educators returned the questionnaires within a week, other educators indicated they needed more time. When the researcher contacted these educators after the three week strike, she found that some educators had mislaid the questionnaires. She handed out new questionnaires to these educators. Some educators indicated they still needed more time to complete the questionnaires. The researcher allowed these educators extra time to complete the questionnaires and made arrangements to pick them up at a later date.

### *3.7.1.3 Delay in the return of questionnaires*

In seven of the ten selected schools, the researcher handed out the questionnaires personally to the educators. With the remaining three schools, the principals or heads of departments preferred to hand the questionnaires to the mathematics educators themselves. At one school the principal had not handed out the questionnaires to the educators after a month. When the public servants' strike had ended, he was not able to locate the questionnaires. The researcher returned to the school and handed out new questionnaires to the educators.

At another school, an educator indicated to the researcher that two questionnaires had been completed and could be picked up. When the researcher arrived at the school, however, one educator indicated that she had left her completed questionnaire at home, while the other said that she had not completed her questionnaire.

### *3.7.1.4 Fatigue effect and the inability to probe responses*

Respondents may fail to answer a questionnaire, or may answer it incorrectly if it is long or monotonous (Dornyei and Taguchi, 2010: 9). This can be attributed to tiredness or boredom. According to Denscombe (2007: 171), questionnaires offer little opportunity for the researcher to test the truthfulness of the responses. Since the researcher is absent at the time the questionnaire is being completed, it is difficult or impossible to probe and follow up on responses. As mentioned earlier, where educators had omitted more than 2 questions possibly due to fatigue or other reasons, the researcher was advised by her supervisor to set up semi-structured interviews with these educators at their convenience to discuss the questions as they had to make up time 'lost' during the strike.

### **3.7.2 Limitations of the focus group interview**

As much as focus group interviews provide a large amount of important information, the focus group interviews did not always go according to plan as the researcher encountered some challenges in interviewing the learners as discussed below.

#### *3.7.2.1 Time*

Since the interviewer has to talk and listen to the participants' responses and ask follow-up questions (Burgess, Sieminski and Arthur, 2006: 72), it does become time-consuming to conduct focus group interviews (Klenke, 2008: 133). They also mention that recording and transcribing the data at a later stage is a time-consuming and complex aspect of data collection. When the researcher conducted focus group interviews at the various schools she was aware that the participants were missing out on tuition and therefore tried as far as possible to keep within the one hour duration, but where learners had more to say, the researcher did not want to curb discussion and therefore allowed them to continue.

The researcher is an educator and she had to request leave from school to conduct the interviews. It was not always possible to use her lunch breaks and non-teaching periods to conduct the interviews at the schools as the time allocated was often insufficient.

After all the interviews, the recordings had to be transcribed verbatim before analysis. This was a very time-consuming exercise.

#### *3.7.2.2 Interviewer bias*

According to Litosseliti (2003: 220), the interviewer may knowingly or unknowingly encourage participants to respond in a specific manner through the use of leading questions. Leading questions and interviewer bias negatively influences the quality of data collected. To overcome this, the researcher used an interview schedule so that the same questions were

asked of all participants. Also the interviews were recorded and transcribed so that responses would be reported verbatim without any bias.

#### *3.7.2.3 Fear among learners*

The researcher found that many learners were afraid to answer the question: What do you like/not like about the way your maths teacher teaches word problems? Learners felt that their mathematics teacher would find out about any negative comments they provided. Despite assurance that their responses would be kept confidential, learners had to be reminded that the information they provided would not be divulged to their educators.

#### *3.7.2.4 Learners' inability to answer questions*

Some learners seemed to experience difficulty in answering the question related to teaching techniques used by their educators. The researcher had to explain the different teaching methods to the learners using simple terminology in order to explain what the question was actually asking, before they could answer.

#### *3.7.2.5 Learners dominating the discussion*

While it may be difficult for interviewers to manage group discussions, Burgess *et al.* (2006: 72) suggest that the interviewer skilfully control group dynamics taking care not to exert too much control on the interview (Hatch, 2002: 132), or allow any group member(s) to dominate the discussion. This power struggle by dominant participants limits the responses of other group members (Babbie, 2010: 323). In all the focus group interviews, the researcher found that one or two learners began to dominate the discussion. This was possibly due to the fact that these learners are generally outspoken and more confident in the use of the English language. Other learners began to withdraw from the discussion apparently due to their poor proficiency in the English language. The researcher very cautiously limited the participation of dominant participants and tactfully drew the quieter learners into the

discussion by using their names when asking questions and by encouraging them to verbalise their thoughts. This helped to increase their responses thereby contributing to a healthy group discussion.

#### *3.7.2.6 Public servants' strike*

Initially the researcher had envisaged to drop off the teacher questionnaires at the selected schools and then make arrangements to return to the schools to conduct the focus group interviews with learners. Shortly after administering the teacher questionnaires the public servants' strike began. The researcher had to wait for the strike to end and for schools to re-open before making arrangements to conduct focus group interviews with learners. Since learners had lost out on three weeks of tuition time, not all principals were keen on interviews being conducted with their learners. Educators were rushing to complete their syllabi and in some schools, learners were preparing to write the September Controlled tests. Those principals who did accommodate the interview, preferred the researcher to conduct the interviews early in the day so as to prevent disruption of lessons later on in the day. With the other schools, the researcher had to wait for the conclusion of the September Controlled tests before making arrangements to proceed with focus group interviews.

### **3.8 DATA ANALYSIS AND INTERPRETATION**

According to Plano Clark and Creswell (2010: 203), data analysis in mixed methods research consists of separately analysing the quantitative data using quantitative methods and the qualitative data using qualitative methods. They add that it also involves analysing both sets of information using techniques that "mix" the quantitative and qualitative data. This is called mixed methods analysis.

The researcher spent considerable time listening to the audio-recordings of the focus group interviews in order to transcribe accurately. The qualitative

data collected from the focus group interviews were transcribed verbatim and analysed to arrive at common themes and patterns.

This study analysed the qualitative data using the following three steps advocated by Miles and Huberman (1997: 10):

- data reduction - the process of sorting and organising data in preparation for the drawing of conclusions;
- data display - the assembly of information in the form of graphs, charts and tables in order to understand the research findings; and
- conclusion - drawing/verification and recognising patterns and themes that emerged from the collected data and testing the validity of the findings.

### **3.9 STATISTICAL ANALYSIS**

Statistical Package for Social Sciences (SPSS) is a computer program that can undertake both descriptive and inferential statistical analyses, present information in tabular or graphical form, import information from existing data sources such as databases or spreadsheets, and produce output that is ready for inclusion in final reports (Cormack, 2000: 413). Muijs (2004: 85) adds that SPSS is a commonly used statistical data analysis software package used in educational research. The SPSS Version 17.0 was used to analyse quantitative data in this study. Whereas quantitative data was recorded manually in the past, in recent years computers have aided researchers in collecting, storing, sorting, analysing and cross-referencing data (McCormack and Hill, 1997: 8). Babbie, Halley and Zaino (2003: 9) state further that data analysis has a greater purpose than just manipulation of numbers - the larger aim is to learn something valuable about human social behaviour. This study used Plano Clark and Creswell's (2010) procedure for quantitative analysis as follows:

- coding of the collected data by assigning numerical values to the raw data;
- exploring the data by looking for patterns and trends;

- analysing the data by means of a quantitative statistical software programme;
- representing the data in graphs, tables and charts; and
- interpreting the results and testing the validity and reliability of the data.

### **3.10 RELIABILITY AND VALIDITY**

Bühringer and Sassen (2010: 11) explain reliability as an indicator of measurement consistency or reproducibility (do we receive the same findings in repeated measurements?) and validity as an indicator of construct concordance (do the findings reflect what we intended to study?). They add that flaws in both properties may lead to completely false conclusions and may limit the generalizability of our findings to the real situation in the universe. To address the reliability of the results, the researcher had carefully prepared a questionnaire for the educators and an interview schedule for the learners. All the focus group interviews were conducted by the researcher in order to eliminate data collector bias, and to maximise the reliability of the results (Wallen and Fraenkel, 2001: 186).

One of the fundamental questions asked by researchers is whether two variables relate to each other, and any statistical relationship between them is called a correlation (Barlow and Durand, 2008: 103). A reliability coefficient is an index which summarizes the relationship between two sets of measures for which a reliability estimate is being made (Gatewood, Feild and Barrick, 2010: 108).

Cronbach's alpha is a commonly reported measure of internal consistency that measures the correlation between items in an instrument (Bhandari and Joensson, 2009). Table 3.1 (overleaf) is a summary of the Cronbach's alpha reliability scores for the ordinal data of this study. The ordinal items in the questionnaire refer to response categories that can be ranked on a continuum ranging from low to high levels (Salkind, 2010: 1473).

According to Johnson and Christensen (2010: 138), a reliability coefficient of zero indicates no relationship between the two measures, whilst a reliability coefficient of one represents a perfect relationship. They add that most researchers want their reliability coefficients to be as close to one as possible, since this indicates high reliability.

*Table 3.1: Cronbach's Alpha Reliability Score*

Cronbach's Alpha	No of Items
0.655	6

A reliability coefficient of 0.700 or higher is considered as “acceptable.” Since the reliability score is close to the acceptable level for social research, this means that the ordinal questions in this study were answered in a consistent manner.

De Vaus (2001) mentions that validity and reliability must be built into the research design. Validity indicates whether the research measures what it was supposed to measure (Mason and Bramble, 1989) while reliability refers to the extent to which the research results are consistent and accurate (Joppe, 2000) even after repeated trials (Carmines and Zeller, 1979). According to Gravetter and Forzano (2008: 157), questions regarding the validity of research are traditionally grouped into two categories: external and internal validity. External validity concerns the extent to which the results from a sample can be generalized to a population and internal validity refers to the measure of accuracy of the results (Joppe, 2000). To prevent threats to internal validity in this study, the researcher used a mixed method approach of collecting data.

To add to the integrity of the research (Newman, Newman and Newman, 2011: 197), researchers merge quantitative and qualitative data; then use the



results to maximise their understanding of the research problem (Onwuegbuzie, Jiao and Bostick, 2004: 143). Hesse-Biber and Leavy (2010: 379) explain further that the quantitative results are compared with the qualitative findings to see whether there is agreement between the two sets of data. If different research approaches lead to the same conclusions then the validity of those conclusions is increased (Clegg, Clegg and Hardy, 1999: 282). In this study both the quantitative and qualitative approaches were used to get an accurate description of the experiences of educators and ESL learners in the mathematics classroom. Hoskins and Mariano (2004) add that multiple methods of data collection increase the reliability, validity or comprehensiveness of a research study. To minimise threats to the external validity, the researcher had selected a random sample that was representative of the target population.

### **3.11 SUMMARY**

This chapter discussed the research methodology, data collection approach and research instruments that were used in this study. The mixed method design which involved qualitative and quantitative research was used to describe and understand how ESL learners learn mathematics and to analyse the results.

The next chapter provides an analysis of the findings of this study and responds to the following questions:

- What are the challenges that second language learners encounter in the learning of mathematics, in particular the section on word problems?
- How can mathematics educators adapt their strategies to teach word problems to second language learners?

## **CHAPTER FOUR**

### **FINDINGS**

#### **4.1 INTRODUCTION**

The previous chapter discussed the research aims, objectives and the research design. This was followed by a discussion of the research methodology, data collection approach and instruments that were used in this study.

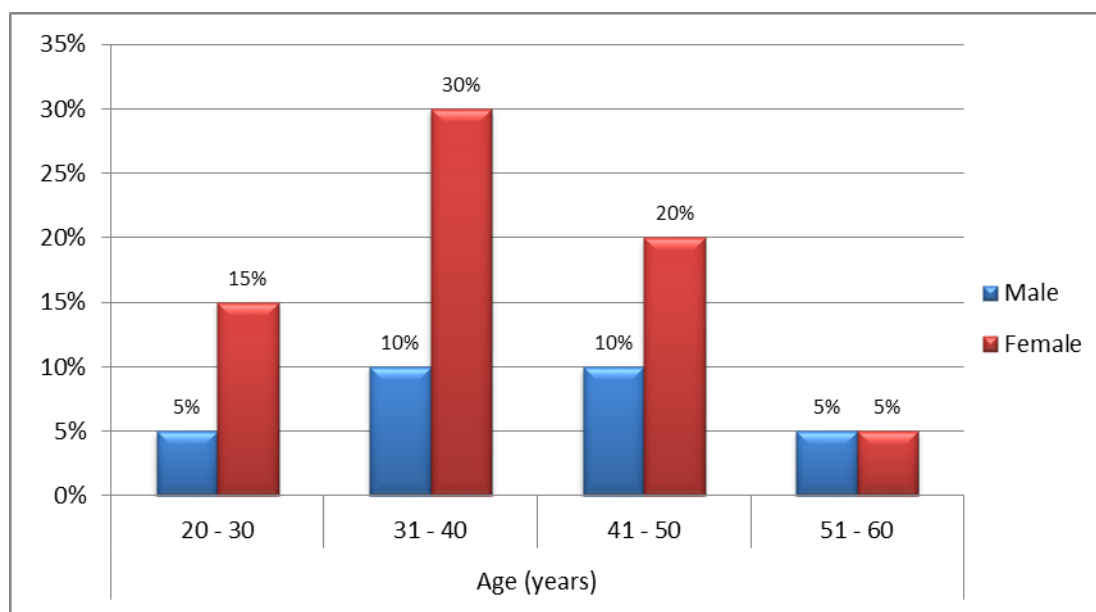
This chapter presents an analysis of data gathered from the educator questionnaires and the focus group interviews with learners. The educator questionnaire was designed to investigate the difficulties that mathematics educators experience with the teaching of word problems in English, and to determine what teaching strategies are being used to help their learners. As mentioned in the previous chapter, the questionnaire was administered to two educators at each of the ten schools, making up a sample of 20. The questionnaires completed by the educators, were analysed using the Statistical Package for the Social Sciences (SPSS) Version 17.0. The qualitative data that was collected through the focus group interviews were transcribed verbatim. Analysis of the quantitative and qualitative data gave rise to major themes, which will be discussed in this chapter. The analysis of data is presented as follows: biographical data of educators, biographical data of learners, followed by a discussion of the themes.

#### **4.2. BIOGRAPHICAL DATA OF THE EDUCATORS**

As indicated in Figure 4.1 (on page 76) 70% of the educators were in the 31–50 year age category. This implies that they have a fair amount of teaching experience (approximately 10–30 years) and should therefore have a good knowledge of subject content and pedagogical skills. The smallest portion of

educators (10%) were in the 51– 60 year age group. This is due to the older more experienced educators having retired. A large number of experienced educators took their severance packages in 1997 in response to a call from the government to adjust the racial demography of the teaching profession (De Klerk and Gough, 2002: 374) leaving South Africa with a shortage of experienced educators.

*Figure 4.1: Age and Gender of Respondents*



Of the 70% that constituted the 31–50 year age group, 50% were female. Of this, 30% were between 31 and 40 years old, and 20% were between 41 and 50 years old. There was an equal representation of males (10%) in each of these two age categories. The ratio of male to female educators was 3:7. This is in keeping with the demographic trend in South Africa where the majority of educators are female (OECD, 2008: 83). The gender composition of school based educators from 2006 to 2008 consisted of 67% female and 33% male (DBE, 2011a: 10) indicating a large gender disparity.

The 20–30 year age category was made up of a larger portion of females (15%) than males (5%). This dominance by female educators is confirmed by

Crouch and Perry (2003) who indicates that there are more females than males entering the teaching profession. A possible reason for this is that men view teaching as an extension of the woman's role as nurturers of young children (Duiker and Spielvogel, 2010: 599), and that they therefore make natural teachers (Klein, 2007: 132). According to Drudy (2005: 112) it is common for men and women to view teaching as a women's job since women are seen to work better with children while men become bored and stressed and look for other attractive careers. Men who do enter the teaching profession feel that teaching has brought them less than what other careers would have offered them (Lortie, 2002: 34). Costigan, Crocco and Zumwalt (2004: 64) add that while most men look for well-paying jobs, female educators choose teaching not for financial gain but to work closely with children and other stakeholders.

Table 4.1 (on page 78) presents a crosstabulation of the number of years of teaching experience, age and gender of the educators. One out of the six male educators and three of the fourteen female educators indicated they were teaching mathematics for less than ten years. Only one female educator indicated that she had more than 30 years of teaching experience. The male educators were equally represented (17%) across the 20–30 and the 51–60 age category as well as between the 31–40 and the 41–50 years age category (33%).

Figure 4.2 (on page 80) provides statistics on the other grades taught by the mathematics educators. All the respondents were teaching mathematics to grade 8 learners, and of these 95 % of the educators indicated that they teach mathematics to other grades.

All the educators indicated that they spoke English, as can be seen in Figure 4.3 (on page 80). Nearly two-thirds (65%) indicated that they also spoke Afrikaans. These teachers have come through the National Education

Table 4.1: Teaching Experience \* Age \* Gender Crosstabulation

Gender				Age				Total	
				20 - 30	31 - 40	41 - 50	51 - 60		
Male	Number of years that you have been teaching mathematics	01 - 10	Count	1	1	0	1	3	
			% of Total	17%	17%	0%	17%	50%	
		11 - 20	Count	0	1	0	0	1	
			% of Total	0%	17%	0%	0%	17%	
		21 - 30	Count	0	0	2	0	2	
			% of Total	0%	0%	33%	0%	33%	
	Total		Count	1	2	2	1	6	
			% of Total	17%	33%	33%	17%	100%	
	Female	Number of years that you have been teaching mathematics	01 - 10	Count	3	2	0	0	5
				% of Total	21%	14%	0%	0%	36%
11-20			Count	0	4	0	0	4	
			% of Total	0%	29%	0%	0%	29%	
21 - 30			Count	0	0	4	0	4	
			% of Total	0%	0%	29%	0%	29%	
> 30		Count	0	0	0	1	1		
		% of Total	0%	0%	0%	7%	7%		
Total		Count	3	6	4	1	14		
		% of Total	21%	43%	29%	7%	100%		

(NATED) system that taught English as a first language and Afrikaans as a second language. 25% of the educators indicated that they could speak an indigenous African language and often used codeswitching in class. The

remaining 75% were unable to speak an African language. The situation of learners speaking languages that are not spoken by their educators is common in South African schools (Mda; 2000: 167).

According to Mulkeen (2010: 45) an educator's ability to speak the main language of a community helps to integrate the educator into that community and to overcome ESL learners' difficulties in understanding the medium of instruction. This is often done through codeswitching. Codeswitching is the process whereby an educator who is knowledgeable in the primary language of a learner, makes considerable use of this language (Holmarsdottir, 2006: 204) to promote learner understanding and attach value to the primary language (Gamble, 2004: 58). Holmarsdottir (2006: 204) lists the following functions of codeswitching in the classroom: to clarify concepts; to encourage learner participation and elicit learner response; to ensure classroom management; and to encourage interpersonal communication. Sridhar and Sridhar (2006: 169) explain that codeswitching does not always signify competence in two languages, but often signifies a lack of competence in two languages. A very interesting observation by Project for the Study of Alternative Education in South Africa (PRAESA) among African educators who codeswitch was that they would use English when they were explaining something they didn't understand themselves (Gamble, 2004: 58). Gamble (2004: 58) explains this was done so that learners could not challenge the educator or ask questions since their English proficiency was weak, so instead of promoting learner understanding codeswitching was used by educators as a cover for not knowing the subject matter they were teaching.

Codeswitching often requires the educator to translate all material to the language that the learner understands. A major drawback is that the lesson now takes more than twice the allocated time (Fleisch, 2008: 109). Another problem is that educators use the African languages to promote understanding during lessons (Hewlett, 1996: 92) but the tests, written assessments and exams are administered in English (Murray, 2002: 439).

Figure 4.2: Grades Taught by Educators

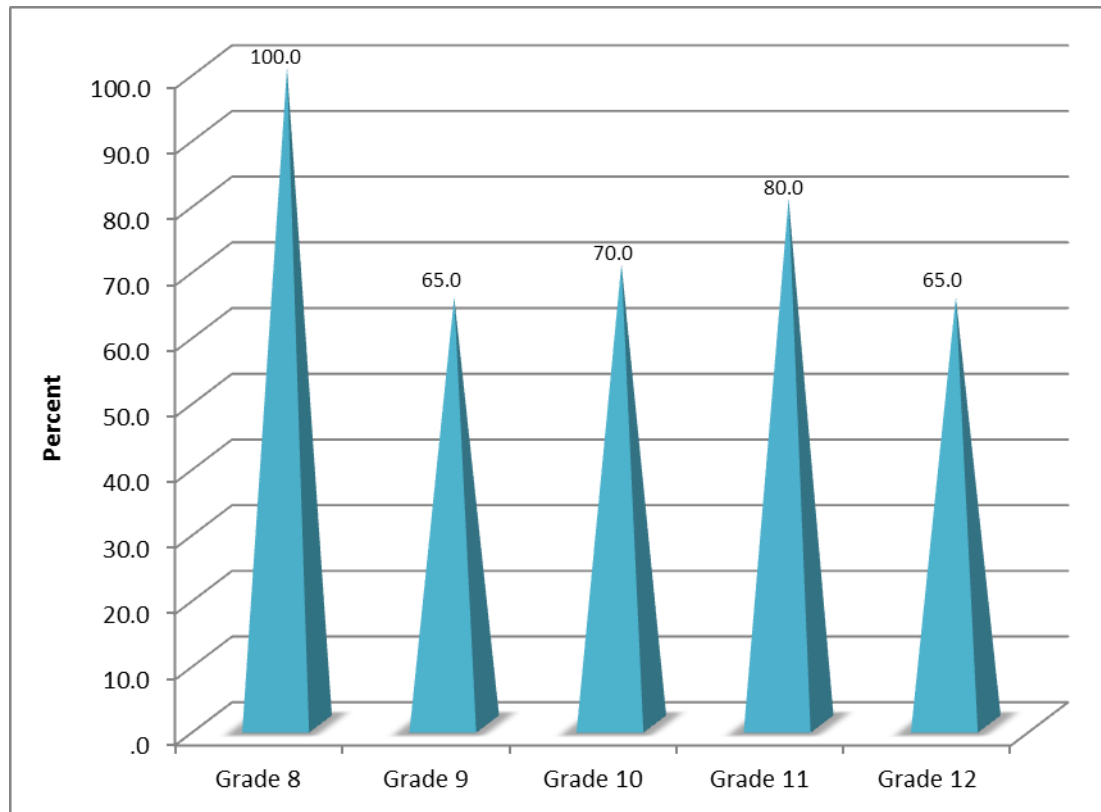
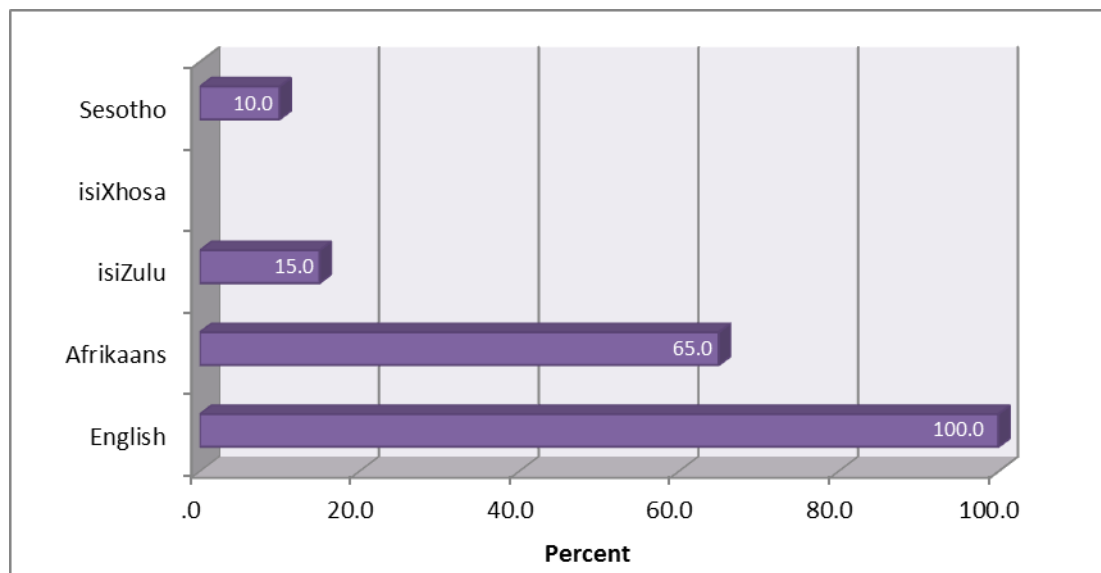


Figure 4.3: Languages Spoken by Educators



Fleisch (2008: 109) explains that codeswitching seldom provides learners with language knowledge in the language of assessment, therefore leading to academic failure. Investigations into educators' switching practices reveal

that educators tend to dominate classroom talk and restrict learner talk (Adler, 2001: 74).

Codeswitching also disadvantages those learners who do not speak the African language being used. As Adler (2001: 141) found, even if the English-speaking educator has knowledge of one African language, this does not address the reality of multilingual South Africa and the other eleven official languages. This is because learners in multicultural classes have different mother tongues (Simon, 2001: 342) and preference is given to one language. Harklau (1994) describes these classes and schools as comprising two separate worlds: the world of ESL learners and the mainstream world where regular teaching of English-speaking learners takes place. Nevaer (2004: 35) adds that codeswitching can create tension and frustration among English-speaking learners especially when ESL learners use their mother tongue to express their feelings about something or someone.

According to Setati (2005: 95) the use of codeswitching is pedagogic and political: pedagogically educators need to switch between languages in order to aid understanding and encourage class participation; and politically learners need access to English as an international language (2005: 98). The latter implies that codeswitching does not prepare learners for the outside world therefore, educators should refrain from codeswitching. English as the medium of instruction will be discussed in detail later in this chapter.

We now look at the biographical data of the grade 8 mathematics classes in the sample schools as provided by the mathematics educators.

### **4.3 BIOGRAPHICAL DATA OF THE GRADE 8 MATHEMATICS LEARNERS**

Table 4.2 (overleaf) outlines the racial composition of the grade 8 mathematics classes, and indicates the percentages of educators who



provided these statistics. 40% of the respondents (eight educators) indicated that their classes had between 90% and 100% of African learners. Only one educator indicated that he had less than 10% of African learners in his class. 25% of the respondents indicated that their classes each had between 50% and 60% African or Indian learners. Two educators indicated that they had less than 10% of Coloured learners in their class.

*Table 4.2: Racial Composition of the Grade 8 Mathematics Classes*

	African	Indian	Coloured
0 - < 10	5	10	10
10 - < 20	0	15	0
20 - < 30	0	10	0
30 - < 40	0	15	0
40 - < 50	5	10	0
50 - < 60	25	25	0
60 - < 70	5	0	0
70 - < 80	20	0	0
80 - < 90	0	0	0
90 - < 100	40	0	0

The focus groups were made up of only African learners who classified themselves as second language speakers of English. 90% of the learners' home language was isiZulu, with the remaining 10% speaking either isiXhosa or Sesotho at home. 60% of the learners indicated that they also spoke English at home, either with their siblings, neighbours or parents. As one learner said, *"I speak English with my sister at home maybe if she got a problem with her daughter she's small so she can't understand English so we speak English so she can't hear us."*

Another learner reported speaking with her younger sister in English at home because the younger sibling is learning the language at school and she wants to learn more. Mda (2000: 166) found that African children who attend multicultural schools are speaking English with each other and with their parents. When schools in South Africa were opened to all race groups in 1994, Sridhar and Sridhar (2006: 173) noted a lack of support by African learners for their home languages and a steady shift towards attending English–medium schools. Research by de Klerk and Bosch (Sridhar and Sridhar, 2006: 174) indicates that African children in the Eastern Cape were required by their parents to speak only English at home in order to develop proficiency in the English language. This is inconsistent with South Africa’s LiEP which promotes multilingualism and encourages the use of learners’ home language as the medium of instruction (Bangura and Setati, 2011: 198). Nkabinde (1997: 101) explains that throughout Africa, foreign languages are being valued more than the local or indigenous languages. This is mainly because African parents associate English with success, power and progress (Schafer, 2005).

Only three learners indicated that they did not speak English at home because:

*“English is for school only,” “my family members don’t speak English,” and “my parents don’t like me to speak English at home.”*

When these learners were asked to elaborate further, they explained that their parents expect them to speak their mother tongue at home. Desai (2006: 128) explains that African parents want their children to maintain their home language in order to stay in touch with their cultural roots. They prefer mother tongue education and would like their children to retain their cultural language (Nkabinde, 1997). Many African parents prefer lessons to be taught in the mother tongue, but ironically choose English as the medium of instruction because they recognise the connection between English and a successful future for their children (Kröner, 2011: 7).

## 4.4 DISCUSSION OF THEMES

One of the ways to report findings from qualitative data is to organise them around the themes that emerge during data analysis (Bui, 2009: 180). Themes refer to patterns in data that reveal something of interest regarding the research topic (King and Horrocks, 2010: 149). Bui (2009: 181) advises that each theme be presented under a separate heading in the data analysis chapter, and that each theme provide a rich description of the research findings.

After analysing the qualitative and quantitative data, the following themes were identified: ESL learners' experiences in the mathematics classroom; assessment; English as the medium of instruction; challenges in solving word problems, and teaching strategies.

### 4.4.1 Theme 1: ESL Learners' Experiences in the Mathematics Classroom

The focus group interviews yielded varying responses with regards to learners' experiences in the mathematics classroom. More than half (60%) of the learners interviewed admitted to experiencing many challenges in mathematics. They say:

*"It's harder than the other subjects and I'm forced to do it at school,"*

*"I don't like it when the work becomes difficult and complicated,"*

*"All the long steps confuse me,"*

*"I find most of the sections difficult,"*

*"Sometimes, mam, I don't understand the maths. . . but I'm scared to ask the teacher because she will scold me because she say I was not listening,"*

*"I know my work but sometimes I make stupid mistakes,"* and

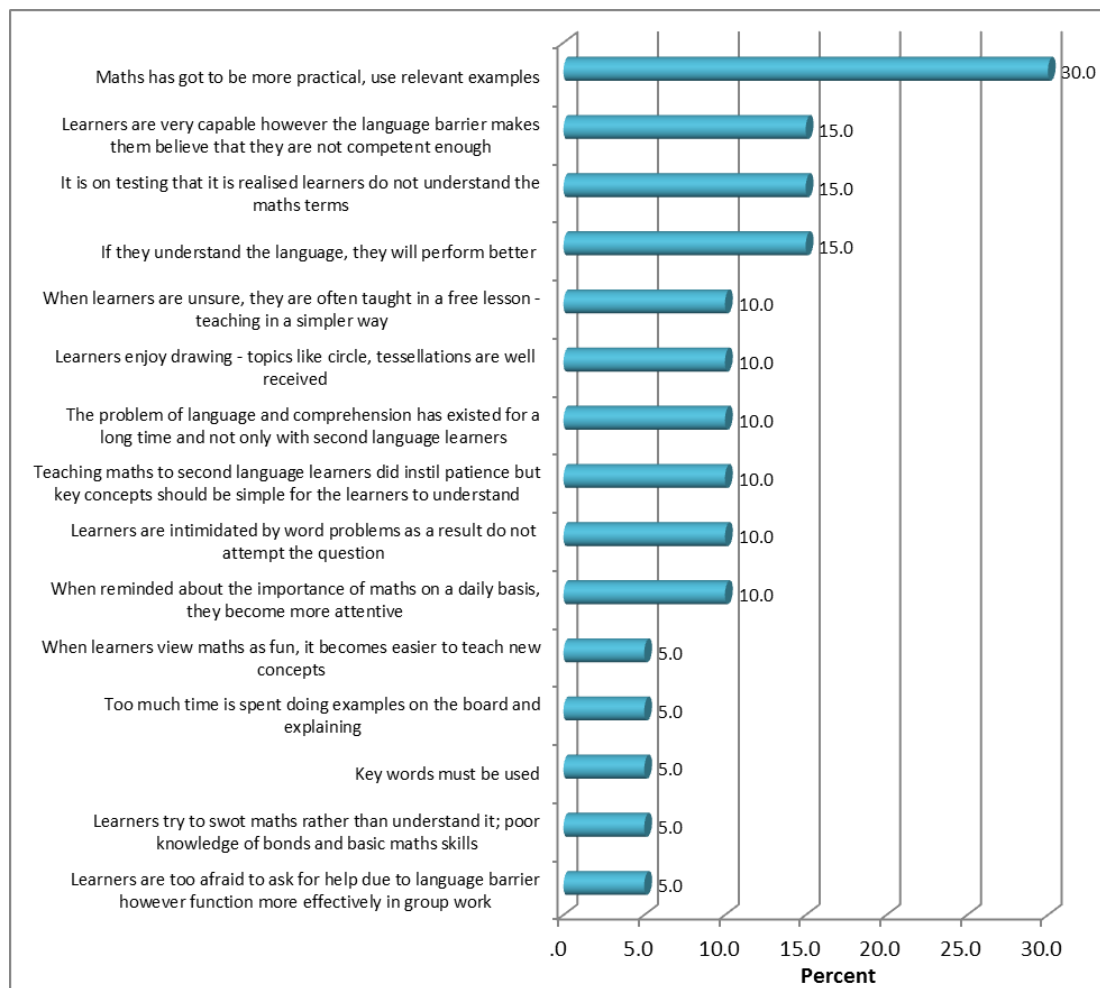
*"Maths is very difficult to understand I would not do it if it was not compulsory".*

The comments above indicate that these learners are finding mathematics difficult. According to Wiliam, Bartholomew and Reay (2004: 51), mathematics is a highly abstract and difficult subject and most learners are assumed to be incapable of making progress in the subject. Since mathematics essentially involves learning a set of skills, Chinn (2004: 113) suggests regular practice and testing in order to provide effective intervention and to improve performance in mathematics. Winter and Hughes (2009: 68) add that making maths enjoyable will cause learners to love maths and will help them learn more in the process. In response to the question: What activities do you enjoy in the maths classroom, the majority of learners (80%) indicated that their mathematics educators do not use activities to make the lessons enjoyable. Other comments ranged from: *"I can't think of any activities"* and *"my mam don't really use any activities that I like"* to *"I like drawing and working with patterns"* and *"I like the way my teacher teaches fractions and percentages, she makes it exciting by cutting up things."* ESL learners must be afforded a range of different activities which provide different opportunities for them to learn (Winter and Hughes, 2009). This is in keeping with comments made by 30% of the educators (see Figure 4.4 on page 86) that important concepts are learnt more easily when mathematics is made simpler, practical and enjoyable. Three learners commented *"I like maths because I find it easy"*, *"it's a very fun subject"* and *"I find it challenging and enjoyable"*. An educator that answered the questionnaire indicated that *"when learners view maths as fun, it becomes easier to teach new concepts"* (see Figure 4.4 on page 86).

The idea of making the learning of mathematics more fun is widely used in India where learners are taught mathematics with recreational activities including puzzles, games and riddles (Rapeepisarn, Wong, Fung and Depickere, 2006: 31). While Rapeepisarn *et al.* (2006: 32) concede that adding play may cause the lesson to detract from the mathematical content and possibly lower the value of education, they emphasise that play involves

learners more in learning and develops their listening, speaking, reading and writing skills. Stevens (2010: 190) reinforces this thinking by saying that when children enjoy doing an activity, they will want to do that activity again. They refer to this as intrinsic motivation.

Figure 4.4: Educators' Experiences with ESL Learners



In response to the question: What do you like about maths, learners acknowledged the importance of mathematics for everyday living.

*“You can be like your own accountant like when you in the shops you can do calculations and stuff because you learnt it at school,” “because it teaches you to count,” and “maths helps you when you go to the bank, and when you go to the shop.”*

The abovementioned comments are supported by 10% of the educators who indicated that “*when reminded about the importance of maths on a daily basis, learners become more attentive.*” Educators therefore need to bring everyday experiences into the classroom. Bottle (2005: 83-84) adds that educators must make use of everyday objects and meaningful contexts to explain to learners the importance and relevance of mathematics for everyday life, as well as to provide reasons for mathematical learning. Educators are expected to adapt their teaching to the learners’ prior knowledge, which stems from learners’ formal and informal contexts and everyday experiences (Schneider and Stern, 2010: 73).

The learning environment plays a major role in providing opportunities for ESL learners to learn. Kersaint, Thompson and Petkova (2008: 57) suggest that the educator builds on the background and knowledge that learners bring to the classroom. Learning, they say, must be constructive in nature. Constructivism began as a theory of learning that asserts that knowledge cannot be transmitted from the educator to learners; instead it is constructed anew by each learner (Matthews, 2008: 349). Johnson (2004: 16) concurs that learning is a matter of creating meaning from daily life experiences. Educators can help learners in this process of acquiring knowledge, by talking in informal ways about ideas and making connections to familiar experiences (Coggins, Carroll, Kravin and Coates, 2007: 2). Educators who share a similar background to ESL learners will understand the importance of incorporating their culture and language into the curriculum (Garcia, 2001). At the same time Kersaint *et al.* (2008: 58) concede that the majority of educators do not have cultural and linguistic connections to ESL learners and therefore feel unprepared to work with them, but they suggest that educators make use of a culturally relevant curriculum and innovative techniques to get learners to verbalise their thoughts (2008: 73). While these educators may feel culturally unprepared to work with ESL learners, the learners in turn generally have difficulty understanding and working with the curriculum.

Brownlie, Feniak and McCarthy (2004: 4) explain that as the subject content and the curriculum become more difficult, so do the challenges for ESL learners. They therefore encourage schools and educators to provide explicit instruction to ESL learners so that they can respond to and benefit from their teaching strategies. In keeping with the constructivist learning theory, just as learners learn to adapt to the culture and dynamics of the ESL classroom, educators must understand the culture of their learners in order to facilitate communication between them (Chiappetta and Koballa, 2002). Kushner and Ortiz (2001: 139) add that educators must use a variety of instructional strategies that accommodate learners' skills, abilities, interests, language and culture. The adaptation of teaching strategies to learners' needs is discussed later in this chapter.

Most often ESL learners require additional support and strategies from their educators, and educators who are struggling to complete the syllabus may be tempted to water down the curriculum. Kersaint *et al.* (2008: 73) warn educators against a "watered-down" curriculum that limits what learners learn and how they learn it. Instead they explain that the goal of teaching is to determine effective strategies that will help ESL learners to develop a thorough understanding of the content. Dong (2004: 18) concurs that linguistically and culturally diverse learners need a rich contextualised content, therefore educators must enrich the curriculum and provide learners full access to it. In order to improve the quality of ESL teaching Téllez and Waxman (2006: 192) suggest that the pre-service curriculum for ESL educators should focus on: a deep understanding of first and second language acquisition; strong content mastery; cross-cultural understanding; acknowledgement of differences; and collaborative skills.

15% of educators (see Figure 4.4 on page 86) attribute learner confusion and misunderstanding to the language barrier which "*makes learners lose confidence in their ability to solve mathematical problems.*" Dawber and

Jordaan (1999) confirm that when learners struggle academically this could lower their self-esteem and confidence and even affect other areas of learning. Haynes (2007: 21) explains that some ESL learners struggle to understand what they read and have difficulty expressing what they know in English. 15% of the educators mentioned that ESL learners are “*generally capable of performing mathematical tasks but the language barrier hinders them, and “if they were able to understand the English language they would be performing well in mathematics.”* Of special interest is the comment made by another 10% of the respondents that “*the problem of language and comprehension has existed for a long time, and does not only affect ESL learners.*” This is discussed later in this chapter.

10% of the educators also found that mathematics sections in which learners are expected to draw, are well received. Most often ESL learners are learning concepts, words and phrases that may not exist in their native language (Arrowood, 2004: 1). In order to help ESL learners develop language proficiency, reading must be contextualised through the use of visuals, demonstrations and field trips (Brownlie *et al.*, 2004: 16), and should include the use of visual displays, dual language texts, groupwork, artwork and bilingual software packages (Hansen and Moore, 2011: 33). Cloud (2005: 137) explains this as scaffolded second language instruction where verbal instruction is accompanied by visuals, actions, demonstrations and models. She adds that multisensory instruction is beneficial to ESL learners since the message is transferred to the learner through different channels at once (2005: 138). Cruz and Thornton (2008: 55) concur that since we live in a visually stimulating society, educators must use visual sources to draw ESL learners in and engage them in stimulating mathematics.

As indicated in Figure 4.4 (on page 86), 15% of the educators responded “*it is on testing that it is realised learners do not understand the mathematical terms.*” Assouline and Lupkowski-Shoplik (2005: 168) urge educators to set challenging tests, which are not unnecessarily frustrating for learners. They



encourage educators to ensure that their tests meet the “Goldilocks Standard”, that is, they must not be too hard, nor too easy, but just right.

#### **4.4.2 Theme 2: Assessment**

*“The maths that mam does in class does not come out in the test papers for us to pass or for us to get more marks, but the difficult things come out in the paper and you have to study everything she tells us.”*

*“Mam, sometimes in the exam time we are doing the revision but in the exam paper some revision is there and some questions is different, so I don’t pass maths quite good.”*

*“I don’t understand nicely when I read from the paper but in class when mam reads and explains then I understand it better and I think it faster, but when mam’s not there I have a problem working out the maths.”*

*“When we writing the test in the class we got the teacher to ask what the word means but in the exam you ask the teacher and she say she can’t tell you what the word means. They say you been in school for so long so why you don’t know so explaining is much more better than doing the work yourself.”*

The above comments by learners during the focus group interviews were supported by an educator who said that learners expect to be “*spoon-fed*”. They get used to the educator’s assistance in the classroom but in the tests and examinations they experience difficulty since the educator is not permitted to help them. Karp and Howell (2004) add that spoon-feeding learners results in passive learners who become helpless and lack confidence in mathematics. 40% of the learners indicated that their mathematics educators explain difficult or confusing words during class tests but did not assist them during examinations. Murray (2002: 439) explains that the examinations which are administered in English, pose challenges for ESL learners who have become reliant on their educators’ use of codeswitching to explain difficult words.

Gordon (2007: 205) explains that ESL learners may be able to speak, read and write in English with confidence but when content knowledge tests are administered in complex English, their limited second language proficiency prevents them from demonstrating their skills. Unfamiliar words prevent ESL learners from deducing word meanings (Marcotte and Hintze, 2009: 79) and can impact negatively on the ESL learner's ability to understand a question (Kersaint *et al.*, 2008: 95). Since ESL learners are generally not familiar with English words that carry key information in mathematics, Brownlie, Feniak and McCarthy (2004: 16) suggest that educators provide ongoing support to these learners, by discussing the meaning of words as they relate to the content and by describing the various ways in which the words are used in different contexts (Marcotte and Hintze, 2009: 79). Rock (2010: xii) argues that words ESL learners struggle with are not always vocabulary words but rather support words. For example, the use of the word "substantiate" in a mathematics test question may baffle the learner and eventually result in the learner not demonstrating his mathematical skill. Dugan (2010: 22) therefore suggests that learners be encouraged to use specialized content words and general academic words both in and out of the classroom in order to aid in understanding.

As mentioned earlier three educators indicated that ESL learners give educators the impression that they understand the mathematics and the question. It is only after testing that educators realise that learners do not understand the mathematics (see Figure 4.4 on page 86). Another educator reported that learners try to swot mathematics rather than understand it. This is supported by Haynes (2007: 85) who found that many ESL learners memorize material for a test without understanding it. She suggests that educators develop alternative assessment strategies, for example, increasing the amount of time allocated for the test; allowing the ESL learner to complete the test after school; giving instructions in the ESL learners' home language and allowing learners to use bilingual dictionaries. Recognising the

effect of proficiency in English on performance in mathematics, the following theme investigates the effect of the English medium of instruction on ESL learner performance.

#### **4.4.3 Theme 3: Medium of Instruction**

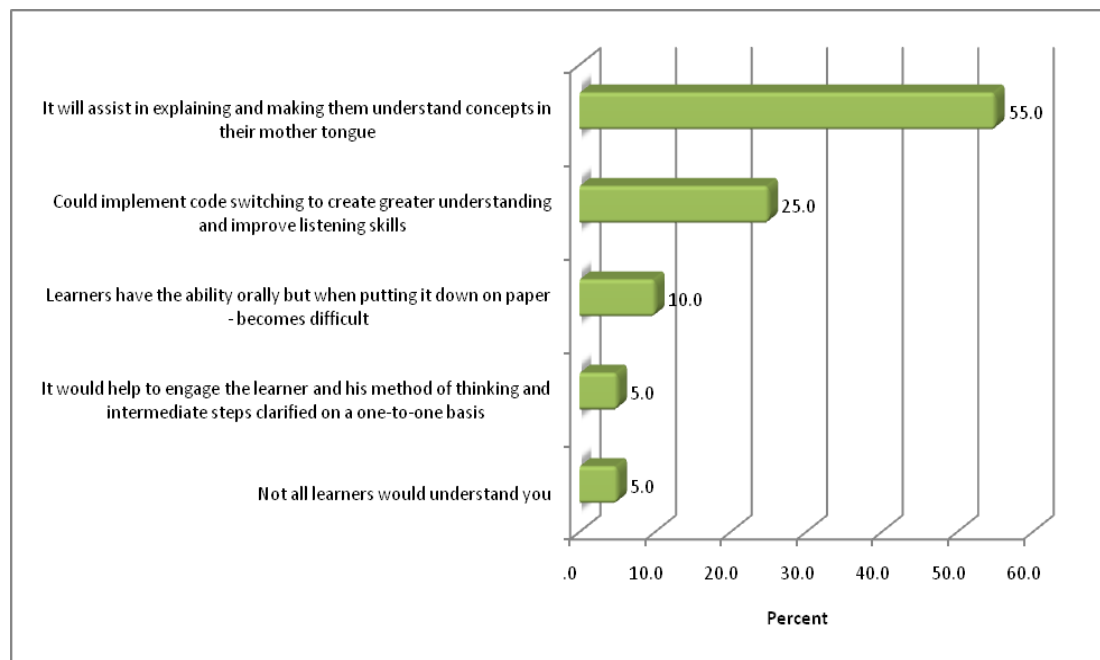
60% of the learner sample had attended primary schools in the former Indian areas where English was the LoLT. African learner enrolments at many former White, Indian and Coloured schools that were close to African townships or the city, have increased significantly following the abolition of apartheid in 1994 (Mda, 1997). These learners reported being taught through the medium of English from as early as grade one, and displayed a fairly good command of the English language. The other languages spoken by these learners were isiZulu and isiXhosa. Fleisch (2008: 3) mentions that while there are a small number of talented learners attending the historically disadvantaged schools, the majority of African learners attending these schools are unable to read for meaning in any language and are numerically incompetent.

Many former Department of Education and Training (DET) urban and rural schools are perceived as having inferior educational standards – these schools are reportedly using the African languages as languages of instruction even when English is the official language of instruction (Mda, 2000a: 52). In contrast, Minow (2010: 17) notes that many African learners who attend former white schools are more privileged than those who attend township schools, and have developed a high level of competence in spoken English. Alo and Mesthrie (2004: 962) also note that some African children who are brought up in middle-class suburbs are now speaking English as a first language. This has contributed to African learners preferring English as the medium of instruction. Mda (2000a: 53) disagrees with this comment, adding that differences in language and culture between the incoming learners and the receiving schools has led to challenges for both parties:

receiving schools are unable to integrate incoming learners with the other racial groups and African learners are having difficulty adapting to English as the medium of instruction.

55% of the educators agreed that the ability of the mathematics educator to speak isiZulu or isiXhosa would be advantageous in explaining mathematical concepts to ESL learners (see Figure 4.5 below). Another 25% of educators indicated this would facilitate codeswitching, which in turn would help ESL learners to understand difficult concepts. Their comments however, were only reciprocated by 40% of learners.

*Figure 4.5: Benefits of the Educator Speaking an African Language*



*“Sometimes when we explain something to our friends in isiZulu they understand it better.”*

*“yes, mam can explain the hard part of maths in Zulu to us,”*

*“the children will understand things faster, mam, if someone is explaining in our own language,”* and

*“the teacher can break down the work and tell you in isiZulu what to do.”*

The educators and learners referred to above, allude to the fact that the main function of codeswitching is to clarify concepts in a language that the learner understands. Adler (2001: 25) points out that in South Africa's complex and diverse multilingual classrooms, the presence of five or six primary languages in one class is not uncommon. As a result the educator's ability to speak an African language is not beneficial to all African learners and indeed all learners in a classroom since they may have different home languages. 5% of African learners, like Fleisch (2008: 109), realise that it is time-consuming for the educator to translate from English to an African language. These learners indicated that their educators were Indian and only taught in English. They feel that the practice of codeswitching wastes valuable tuition time and is unfair to the non-African learner.

30% of the learners indicated they have grown accustomed to being taught through the medium of English in primary school and are not in favour of being taught through an African medium in secondary school.

*"We went to the Indian primary school so the teacher was teaching us in English, now we find it easier to learn the maths in English."*

*"We learn English from primary school, some children might get confused if the teacher use another language."*

*"We came from the English school so we don't know Zulu well, we don't speak it the same like the books. Zulu is hard in the books."*

*"Lots of words can't be explained in isiZulu. . . for example division, multiplication. . . so I find it easier if my teacher explains in English."*

*"It's difficult to translate English to isiZulu. . . it won't have the same meaning. . . they will have to use more words or say it in a different way. . . to explain one word they will have to use many words in isiZulu."*

*"Since we started in the English school, since we are in grade R we can't understand Zulu, the hard Zulu. We only know the easy Zulu, so it is English that we understand it better because all the subjects we are learning in English."*

*“We have lots of Indian children in our school so it’s not fair to them if the teacher explains in English and isiZulu, it will waste lots of time to explain.”*

40% of the learners mentioned the different varieties of isiZulu being used by educators. The learners explained that they use the low variety of isiZulu at home, but the isiZulu that was used at primary school was difficult to understand. The learners expressed concern that if they were to learn mathematics through the medium of isiZulu, it would be difficult for them since the isiZulu they speak at home is of a lower standard than the isiZulu they were exposed to in primary school. This is in contrast to studies by Ntshangase (1995: 295). He found that educators who teach isiZulu usually switch to a low variety of isiZulu to explain difficult concepts. Learners went on to explain that the textbooks used in primary school were written in isiZulu and were very difficult to understand.

15% of educators (see Figure 4.4 on page 86) felt that if ESL learners had a better understanding of the English language *“they would perform better in mathematics.”* 30% of the learners were in agreement that greater proficiency in the English language would allow them to: *“understand what the teacher was saying;” “concentrate on the lesson;” “answer questions;”* and *“understand the textbooks”* since they are written in English. Valdés, Bunch, Snow and Lee (2005) confirm that learners can only learn a curriculum in English when they understand the English language. Kushner and Ortiz (2001: 147) agree that limited proficiency in English disadvantages learners and denies them opportunities to learn successfully in classrooms where lessons are taught entirely in English.

The following four learners, from different schools, disagreed with the above points of view:

*“I don’t think so even when I understand English, sometimes I don’t understand the maths.”*

*“Children who are not very good in English can still do well if they spend time doing maths”.*

*“If you know how to understand how the whole maths question is done then you won’t have a problem so you don’t have to be good in English to understand it.”*

*“Not really, not so much of the English is used in maths, you don’t need English to do the maths calculations.”*

These learners maintain that mathematics is not language-based but method based, therefore practice allows the learner to choose a method which is appropriate to the question. Hargis (2005: 63) agrees with Jones (2003: 105) that multiple exposure to mathematical facts and skills facilitates memory, as long as the prerequisite skills and foundation knowledge have been learned. Schiro (2009: 5) however, maintains that mathematics is not an activity where learners memorize facts, rules and formulae and then replicate them. Instead, mathematics involves the solving of problems through thought, reasoning and communication (Schiro, 2009: 5).

One learner mentioned that even with a good understanding of the English language she is sometimes still unable to understand the maths. She explains further that ESL learners have now begun *“using language as an excuse for not understanding the work - when they do badly in a test they say they don’t understand the language, but this is not true.”* It would seem that some ESL learners may understand the English language being used but when they perform poorly in tests they automatically use the language barrier as a reason for poor performance. Valencia and Buly (2010: 20) point out that although good educators try to meet the individual needs of ESL learners, in diverse multilingual classrooms it becomes difficult for educators to keep a close watch over all learners and to diagnose the root of individual learners’ academic failure.

As mentioned in chapter two, a section in the grade 8 mathematics syllabus that ESL learners experience difficulty in is that of word problems. The next theme explores challenges that ESL learners experience in learning mathematics, with specific reference to word problems.

#### 4.4.4 Theme 4: Challenges in Solving Word Problems

Educators find that teaching learners how to solve word problems is one of the most difficult sections in the mathematics syllabus (Griffin, Leong, Stepanek and Lavelle, 2010: 110). Word problems are questions that require the application of maths to achieve a solution, but in which the appropriate procedure needs to be identified from within the sentences (Orton, Orton and Frobisher, 2004: 57). Kersaint *et al.* (2008: 113) attribute learner difficulty to the specialized nature of mathematical language.

Figure 4.6: ESL Learners' Performance in Mathematics

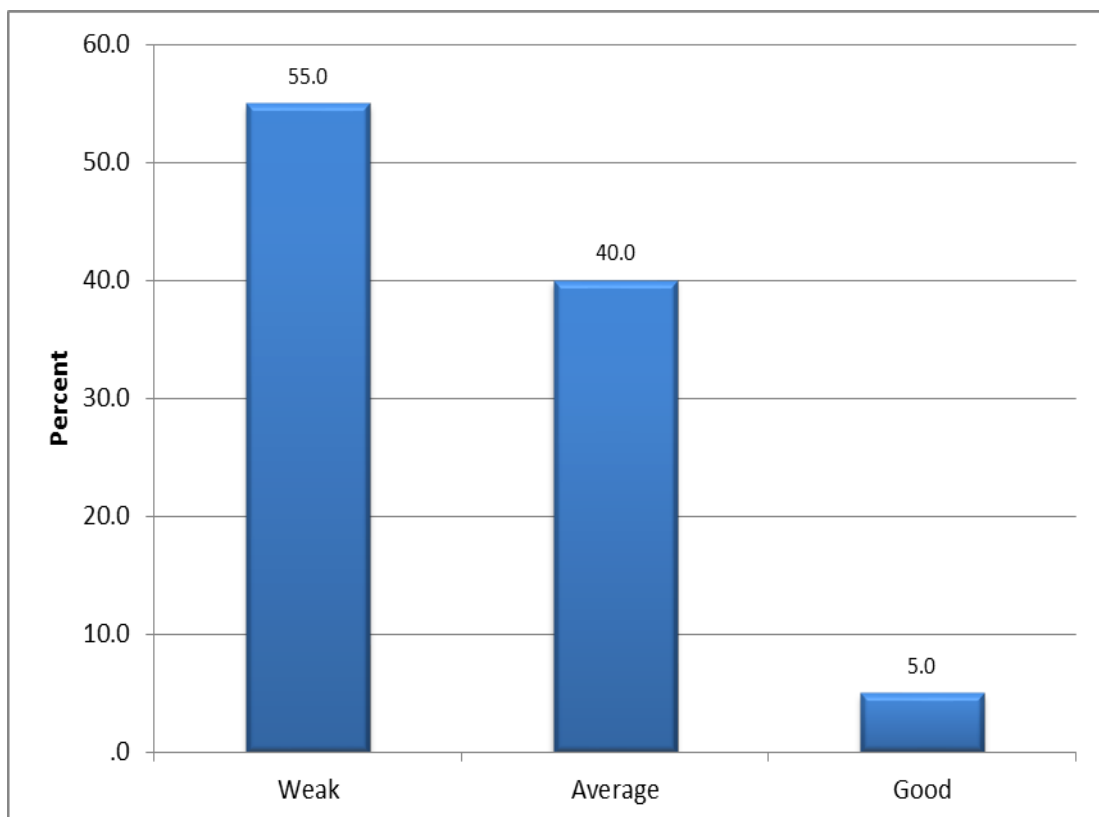




Figure 4.6 (on page 97) describes the performance of ESL learners in mathematics, while Table 4.3 (below) describes their performance in mathematical word problems. More than half of the educators (55%) indicated that ESL speakers generally performed poorly in mathematics. Only 5% of respondents indicated that ESL learners were proficient in mathematics.

Seven in every ten teachers (70%) indicated that word problems were poorly answered. None of the respondents were satisfied with the ability of second language learners to solve and/or interpret word problems. Possible reasons for learners' poor performance in mathematics and word problems are indicated in Figures 4.7 and 4.8 (both on page 99).

*Table 4.3: Performance in Word Problems*

	Frequency	Percent	Valid Percent	Cumulative Percent
Weak	14	70.0	82.4	82.4
Average	3	15.0	17.6	100.0
Total	17	85.0	100.0	
Missing System	3	15.0		
Total	20	100.0		

The six most common reasons for poor performance in mathematics were related to the following: poor comprehension skills (45%); language barrier leads to poor results (35%); poor decoding (30%); incomplete homework and high absenteeism (25%); poor foundation knowledge (20%); and fear of asking questions (15%).

Figure 4.7: Reasons for Poor Performance in Mathematics

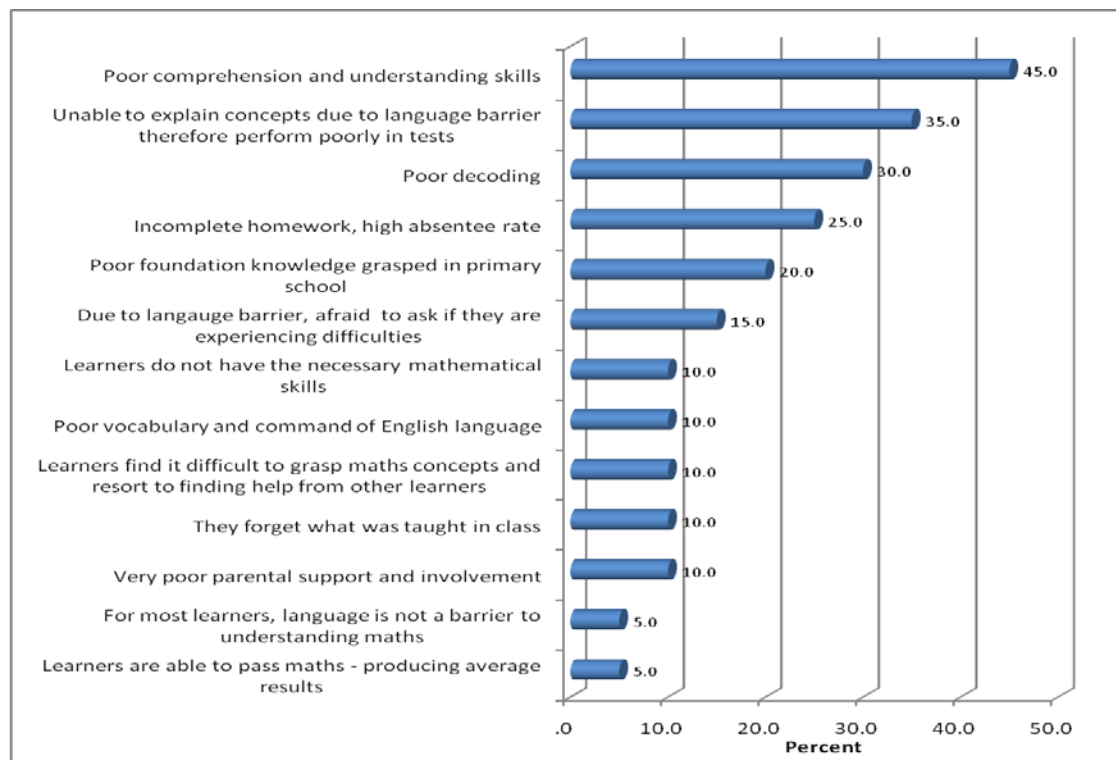
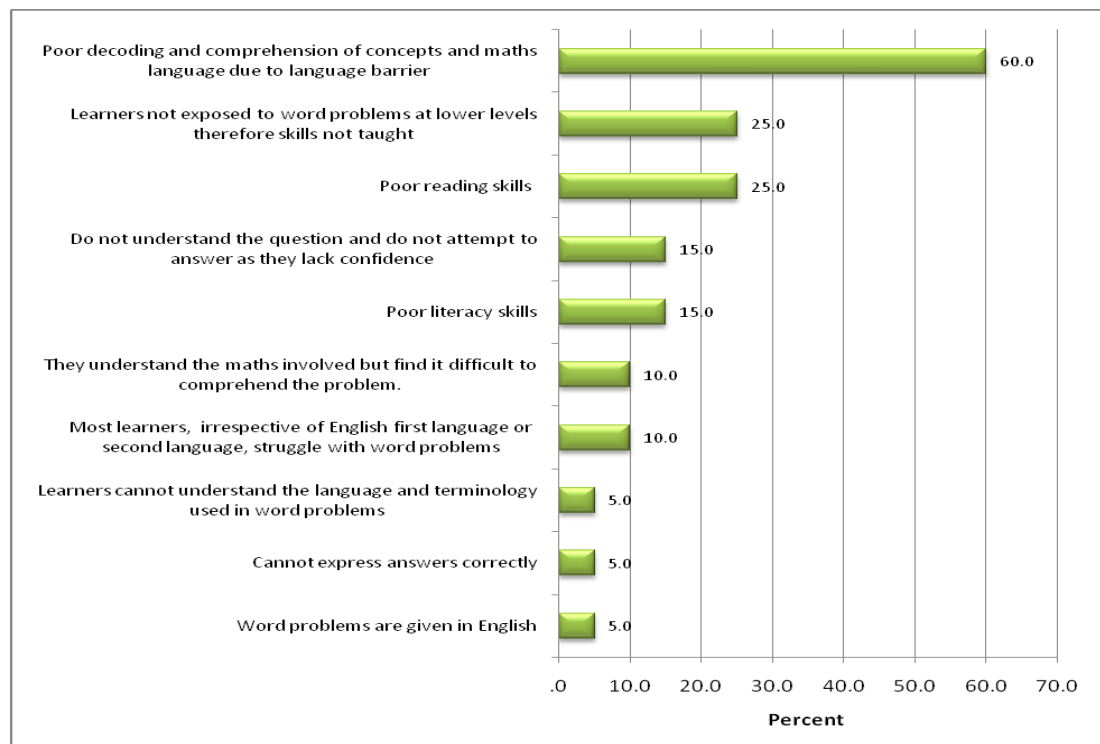


Figure 4.8: Reasons for Poor Performance in Word Problems



There are some commonalities with the reasons given by educators for ESL learners' poor performance in mathematics and in word problems. The common reasons (see Figure 4.8 on page 99) were: poor decoding and comprehension skills due to the language barrier (60%); learners not exposed to word problems in the lower grades (25%); poor reading skills (25%); lack of confidence (15%); and poor literacy skills (15%). These reasons as identified by the educators will now be discussed.

60% of the respondents in Figure 4.8 identified language as being the primary barrier. Educators mentioned that ESL learners were unable to solve word problems due to their poor understanding of the language used in the word problem. Among the other reasons given, 25% indicated poor reading skills and 15% cited poor literacy skills. The educators mentioned that ESL learners are probably not reading enough English medium literature, resulting in poor reading and literacy skills. Crandall *et al.* (1985) explain that language skills and reading skills are required for learners to learn and apply problem-solving skills. Mather and Jaffe (2010: 556) add that even when ESL learners master basic reading and writing skills they may still struggle with higher level linguistic abilities such as the acquisition of vocabulary and reading and listening comprehension. Everhart (2011: 65) concludes that language difficulties are a result of: poor understanding of mathematical vocabulary; limited ability to read the word problem; and limited verbal ability to explain thinking.

One educator mentioned that “*some ESL learners have a good command of the English language but are surprisingly having difficulty in mathematics.*” Frei (2007: 74) explains that ESL learners learn concepts and language simultaneously, so while they may have acquired social language skills, they may experience difficulty with the academic language used in Mathematics. Bahr, Bahr and Degarcia (2008: 343) concur that ESL learners often appear linguistically proficient, but are underachieving in content area. Closely linked

to learning and language difficulties, is learners' lack of confidence, as identified by 15% of educators (see Figure 4.8 on page 99). ESL learners who have difficulty understanding and solving word problems feel a sense of despair and worry, as a result they tend to: give up; guess an answer; or copy the solution from another child (Westwood, 2008: 17). Westwood therefore suggests that educators teach their learners effective strategies to attempt classroom tasks (2008: 17). Teaching and learning strategies relating to word problems are discussed later in this chapter.

One of the reasons mentioned by educators (30% of educators in Figure 4.7 60% of educators in Figure 4.8) for learners' poor performance in mathematics and word problems is poor decoding skills. Decoding refers to the basic reading and recognition of words (Day, Spiegel, McLellan and Brown, 2002: 152). Linan-Thompson and Vaughn (2007: 59) explain that poor decoding is common among ESL learners especially since English is one of the most challenging alphabetic languages to decode. Garcia (2003: 37) suggests that educators help ESL learners to decode familiar words and teach them the definitions of new words as they decode them. Closely related to ESL learners' poor comprehension is the issue of poor test results.

ESL learners are faced with the dual task of acquiring English as a second language as well as learning mathematics in English, therefore their academic achievement depends on how well they accomplish this task (McTigue, 2008: 5). Huerta (2007: 218) adds that even ESL learners with a good understanding of mathematical concepts perform poorly in tests mainly because their language skills are lower than that of the test. This was evident in the Third International Mathematics and Science Study (TIMSS) tests where ESL learners' performed extremely poorly in mathematics (Howie, 2003a). The TIMSS test is an international study that measures Grades 4 and 8 learners' competence in mathematics and science (OECD, 2008: 54). The lowest levels of performance were noted in the former African schools.

Insufficient work covered in the foundation phases was reported by 20% of educators (in Figure 4.7) and by 25% of educators (in Figure 4.8). Educators reported that learners' lack of foundation knowledge from primary school have resulted in learners not having acquired the necessary problem-solving skills required at grade 8 level. Kanjee and Prinsloo (2005) assert that learners' poor quality of foundational knowledge leads to poor academic performance. This comment raises the question: Who is to blame for ESL learners' poor foundation knowledge?

Adler, Slonimsky and Reed (2002) maintain that it is vitally important for educators to have a good grasp of their subject matter in order to engage learners in high-level conceptual learning. Phurutse (2006: 222) agrees that for schools to produce good results at secondary school level there should be consistent monitoring of teaching in the lower grades. Farenga and Ness (2005: 61) in their response to foundational knowledge in mathematics distinguish between the traditional and constructivist view of mathematics instruction: while traditionalists encouraged the memorizing of mathematical facts and computational skills in a rote manner, constructivists assert that mathematical instruction ought to focus on inquiry and understanding. Kintsch (2009: 234) concurs that constructivism is a theory of comprehension and learning, which focuses on the construction of meaning and the acquisition of knowledge. She adds that learners do not acquire knowledge by osmosis but are actively engaged in knowledge building. The likelihood of ESL learners remembering foundation knowledge is heightened when they actually understand what it is that they are learning.

While secondary schools blame primary school educators for learners' poor foundational knowledge, some ESL learners are blaming educators for not explaining concepts adequately. One learner commented *"sometimes I feel angry with the teacher because I feel she didn't explain it properly, if she explained it properly I won't have a problem."*

The quality of mathematics educators in South Africa has often been questioned. Educators have been accused of having poor content knowledge and of not being able to teach effectively (CDE, 2007: 27). In fact the TIMSS 2003 study which compared South African and international educators revealed that South Africa's mathematics and science educators are one of the least qualified groups (Reddy, 2006: 116). In order to improve teaching and learning, it is imperative that educators have an excellent content and pedagogical knowledge (NCTM, 2000). Ottevanger, Van den Akker and De Keiter (2007: 43) suggest that an educator should master the subject at a level 2 to 3 years higher than the level being taught. They explain that an educator's understanding of the subject matter will allow him or her to answer learners' questions with confidence. Within the new South African mathematics curriculum, Graven (2005: 220) outlines the following four roles for educators: to serve as a deliverer of mathematical knowledge; to prepare learners to critically analyse the way in which mathematics is used socially, politically and economically; to develop the curriculum and apply mathematics in everyday life; to be an exemplary mathematician and teach learners ways of investigating mathematics.

25% of educators (see Figure 4.7) reported that incomplete homework and high absenteeism results in poor performance in mathematics. According to Seo (2007: 168) homework is an important part of the learning process for ESL learners mainly because they absorb knowledge as they work on their homework. Arrowood (2004: 74) adds that homework helps ESL learners to get used to concepts in another language and practice ensures that they calculate answers correctly in the future. Since there is a positive correlation between homework completed and mathematics achievement (Pelletier and Normore, 2007), it stands to reason that ESL learners will benefit from completing homework. On reviewing South African learners' poor results in the TIMSS tests, Shen (2001) found that high absenteeism has a significant negative effect on learner achievement. In order to improve mathematics learning in South African schools Reddy (2006: 109) advises all roleplayers,

especially learners and educators, to work towards facilitating a more conducive teaching and learning environment.

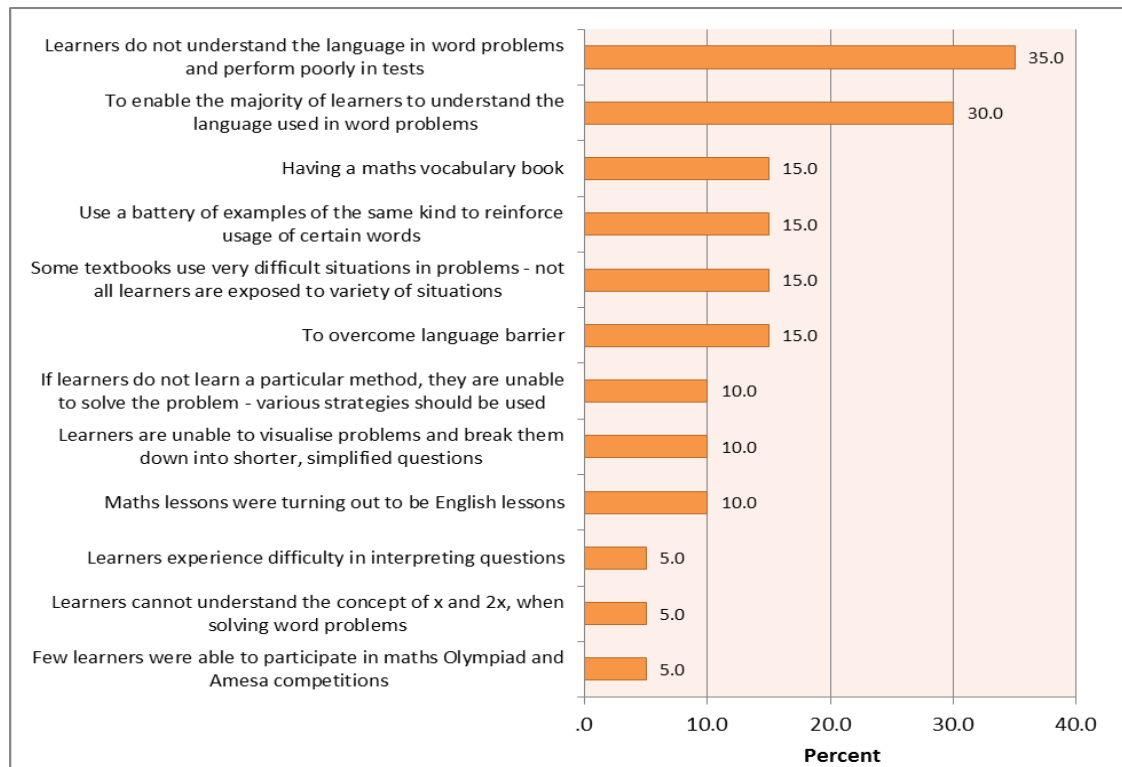
#### **4.4.5 Theme 5: Teaching Strategies**

Apart from reading and language difficulties, word problems pose challenges to ESL learners because they must: understand what the question is asking; locate the relevant information; set up the problem correctly; and determine what operations to use to solve it (Reid and Lienemann, 2006: 121). Taking into account the many difficulties ESL learners face in solving word problems perhaps the following words by Ignacio Estrada, as quoted by Bartlett (1989), has specific meaning: if a child can't learn the way we teach, maybe we should teach the way they learn.

In the traditional classroom mathematics is generally taught using the transmission mode of teaching, where learners are likened to empty vessels ready to be filled with knowledge (Wright, Stafford and Stanger, 2006: 49), however this idea that learning is a mechanistic process of breaking down knowledge into smaller units for learners to digest mentally is now obsolete (Hall and Burke, 2004: 5). Instead in the constructivist classroom learners are expected to construct their own mathematical knowledge, develop mathematical concepts as they engage in mathematical thinking, and try to make sense of methods and explanations (Wright *et al.*, 2006: 49). It is incumbent on the educator to use a variety of teaching strategies to ensure that ESL learners succeed with the curriculum by customising learning tasks to learners' needs in a meaningful and worthwhile manner (Everhart, 2011: 81). All educators in this study indicated that they did have need to change or adapt their teaching strategies when teaching ESL learners. Their reasons are indicated in Figure 4.9 (overleaf).

Educators indicated that learners did not understand the language used in the word problems, therefore 15%, 30% and 35% of the respondents

Figure 4.9: Reasons for Changing or Adapting Teaching Strategies



respectively adapted their teaching strategies to: help learners overcome the language barrier; understand the language; and improve their test results. 15% added that the word problems given in textbooks are often difficult and impractical. Elbers and Streefland (2000) suggest building lessons around problems that are relevant and meaningful for the learners. According to Martin and Loomis (2006: 215), in the constructivist classroom the most effective way to keep learners' attention and prevent discipline problems is to present interesting and meaningful lessons that engage them. They add that the best educators are those who meet learners' needs by engaging them in meaningful and stimulating studies. Educators are therefore expected to adapt their teaching strategies in order to expose learners to a variety of situations. When learners gain practice solving different types of word problems, this will help them build strategies for solving other problems (Griffin *et al*, 2010: 112).



Figure 4.10: Teaching Strategies Used by Educators

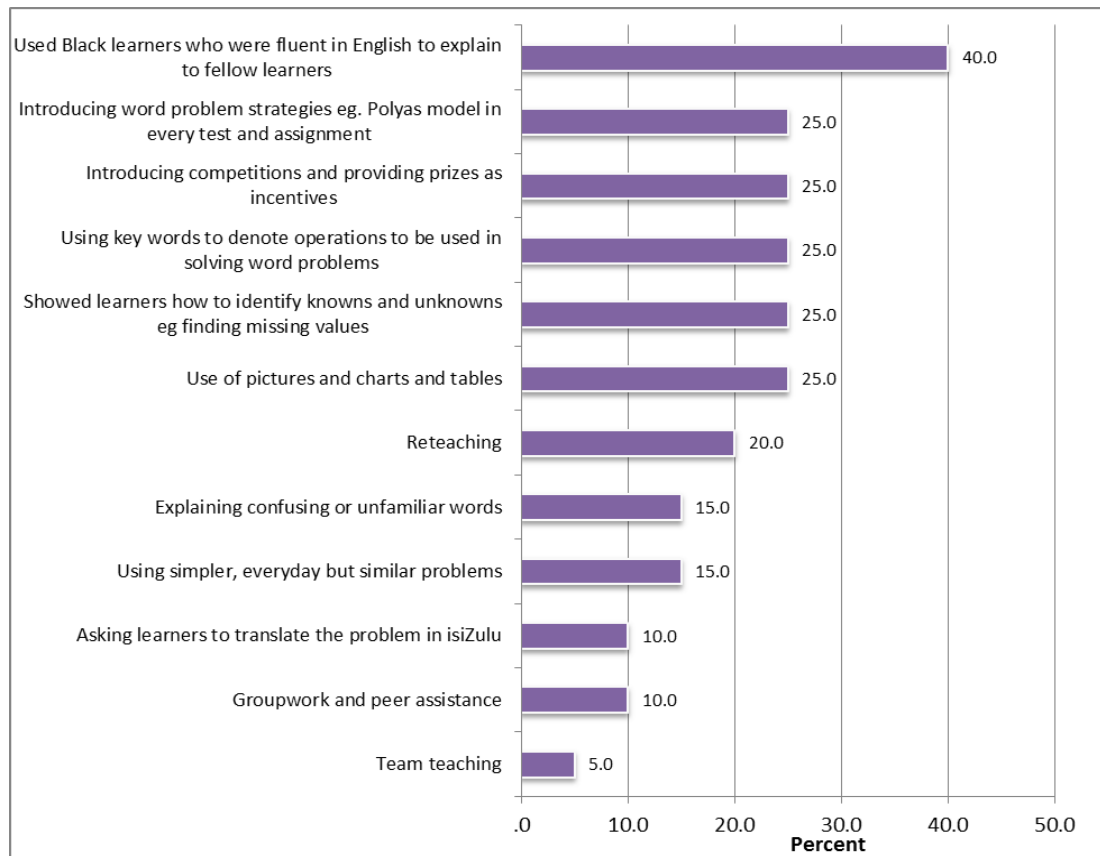


Figure 4.10 (above) reveals that most of the respondents (40%) used peer learning/teaching that was initiated by the educator. A quarter (25%) of the respondents each used the following methods to help, encourage and stimulate learners: Polya model; competitions and incentives; highlighting key words; highlighted techniques; and pictures, tables and charts. According to Kersaint *et al.* (2008: 115) Polya's problem-solving model, which is an effective strategy in the teaching of word problems, comprises the following four processes:

Understand the problem: learners must understand the context of the problem and what is required.

Devise a plan: learners must make a decision about which approach to use to solve the problem.

Carry out the plan: learners must implement their plan.

Look back: learners must check their results against the information provided in the problem.

20% of the respondents resorted to re-teaching the lesson(s), while 15% of respondents each indicated they explained unfamiliar words in the questions and used simpler and similar problems to teach problem-solving skills. Since unfamiliar words can impact negatively on the ESL learners understanding of the word problem, Kersaint *et al.* (2008: 95) suggest that educators write these words on the chalkboard, explain them and then ask learners to form their own sentences using these words. As ESL learners have low reading comprehension skills, Haynes (2007: 64) recommends that educators use simplified language and link new knowledge to background knowledge. Zegarelli (2007: 85) encourages educators to break up the word problem into separate sentences, to write down all relevant information, and then convert the words into numbers and symbols in order to form an equation. Another challenge that educators face in providing quality education to ESL learners is large class sizes.

In South Africa the average class size is 45, while the international average number per class is 30 (Reddy, 2006: 110). Large class sizes make it difficult for educators to control the learners and teach at the same time (Saraswathi, 2004: 154). Chisholm (2005) adds that high pupil:educator ratios increase the amount of marking and record keeping required of educators, and prevents educators from giving individual attention to learners with definite challenges. Schwartz (2005: 126) suggests that when working with large class sizes educators use strategies that will attract and hold learners' attention.

To a large extent the change or adaptation of teaching strategies proved to be successful in the ESL classroom as indicated by 25% of respondents. Improvement was noted since learners were able to visualise and understand the word problem. 15% of respondents indicated that while some learners improved, other learners still experienced difficulty understanding word problems. Another 10% of the respondents mentioned that a change in teaching strategy was effective but only to a certain extent, due to learner apathy and poor work ethic. Krutetski, a Russian psychologist, investigated

the teaching strategies employed by an educator in Moscow after it was discovered that her learners scored higher on word problems than any other learner in that district (Brown and Liebling, 2005: 180-181). It was discovered that she taught mathematical word problems as language lessons for a few weeks, deliberating over terminology and special vocabulary before focusing learners' attention on the mathematics.

If learners are having difficulty understanding word problems Everhart (2011: 65) suggests that educators try the following strategies: rewriting the problem on the comprehension level of the learner; reading the problem aloud; practising mathematics vocabulary; asking learners to picture the problem in their minds; breaking the problem into smaller parts; allowing the use of manipulatives; getting learners to roleplay the problem; repeating the problem but changing the numbers; guiding them to a similar problem that has already been successfully solved; and teaching learners to use a problem-solving model that meets their needs

Different sections in mathematics lend themselves to the use of different teaching methods. Furthermore learners and educators may prefer different teaching methods to be used in the various sections in mathematics. Educators were questioned as to which teaching method they found most suitable for the teaching of word problems. While half the respondents (50%) indicated that group discussion was most suitable to the teaching of word problems, 10% of the respondents favoured individual work and 20% preferred whole class discussion. Twenty percent (20%) of respondents did not answer the question. In the ESL classroom groupwork allows the educator: to involve learners in classroom discussion; to build important vocabulary from the mathematical concepts; to connect mathematical language to social language and to give attention to mathematical symbols (Kersaint *et al.*, 2008: 95-100). Although 50% of the educators mentioned the benefits of groupwork and they indicated they used groupwork in teaching word problems to ESL learners, learners indicated otherwise. This technique

was least used probably due to the noise factor and educators' inability to manage and control group activities. The focus group interviews revealed that the methods most commonly used by mathematics educators were whole class discussion and individual work.

*"Mam explains then she tell us what to do."*

*"Mam will discuss, if we don't understand then she repeat."*

*"Most of the time she uses individual work but sometimes it's whole class discussion."*

*"Mam use individual work because the class make too much noise."*

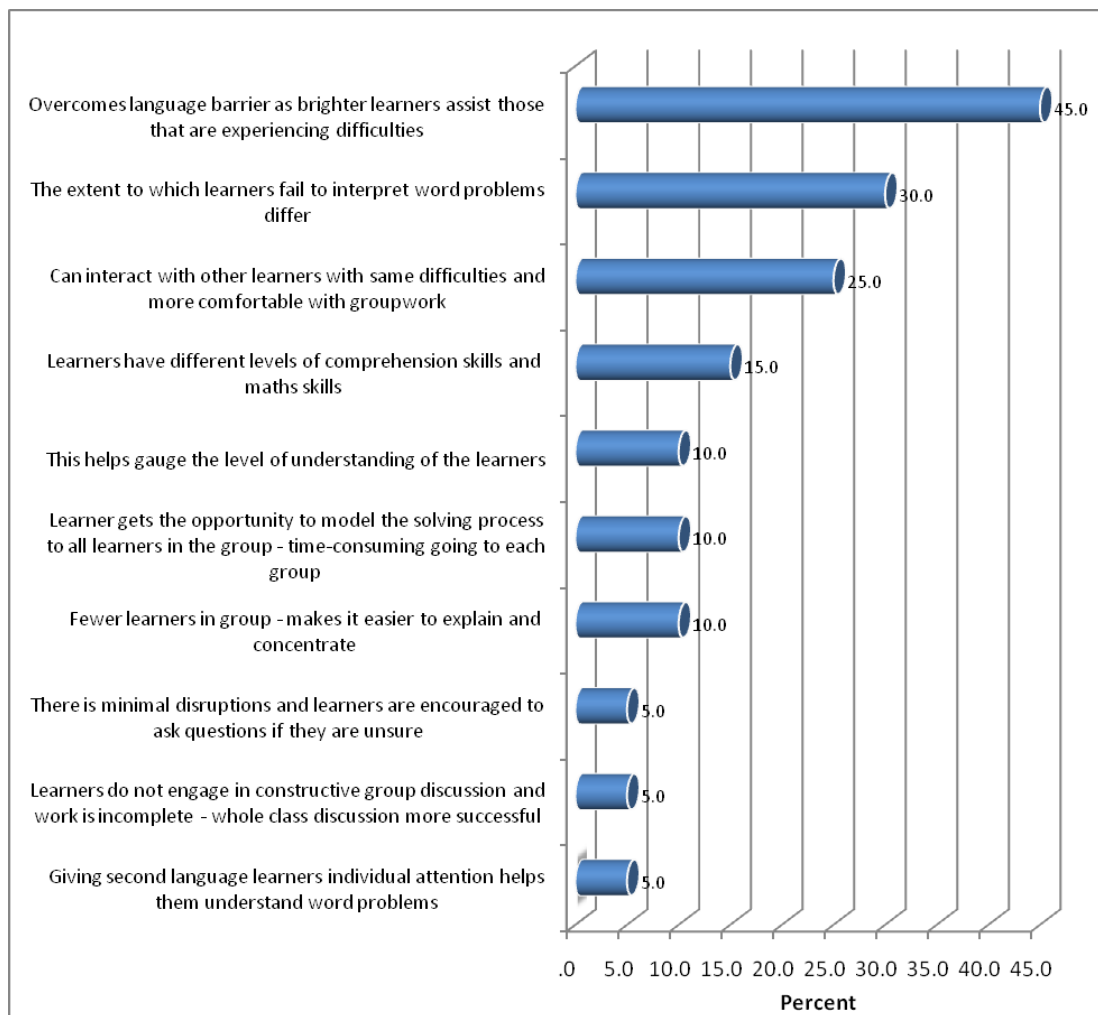
*"Individual work, we do the work but mam also explain."*

Learners seem to think that whole class discussion is most feasible for the educator *"who is able to speak to the whole class at one time"*. This is possibly due to the fact that whole class teaching allows educators more control over classroom discipline. The educator introduces a mathematical problem, analyses it through discussion with the class and together they come up with potential solutions (Partin, 2009: 193). Individual work on the other hand, allows the educator to walk around the classroom; observe how learners attempt mathematical problems; and help learners as they work. Pritchard (2007: 28) adds that educators prefer individual work, since a quiet classroom can lead to productive work and effective learning.

Nearly half (45%) of the respondents encouraged group discussions because it provides a mechanism for the "bright" students to assist the weaker students within that forum (see Figure 4.11 overleaf). 30% of respondents indicated that the extent to which learners fail to interpret word problems differ, therefore groupwork provides a platform for these learners to voice their difficulties, to ask questions and to learn from other group members (Coggins et al., 2007: 37). It is highly probable that ESL learners have common concerns regarding word problems. A quarter (25%) of the educators reported that group discussions ease the pressure they are feeling allowing them to work comfortably with each other. 15% of the respondents

contend that since learners have different levels of comprehension and mathematical skills, groupwork allows even the weakest learners to learn from the experiences of other group members and progress to a higher level of understanding. Studies by Streefland confirm that during groupwork the least talented children are encouraged to participate in the process of constructing mathematical meanings (Elbers, 2003).

*Figure 4.11: Educators' Reasons for Choice of Teaching Method*



Educators were also asked which teaching method/s their ESL learners enjoy. As indicated on Table 4.4 (on page 111) approximately two-thirds (65%) of the respondents said that group discussions were enjoyed most.

Table 4.4: Teaching Methods Enjoyed by ESL Learners

	Frequency	Percent	Valid Percent	Cumulative Percent
Group discussion	13	65.0	81.3	81.3
Whole class teaching	2	10.0	12.5	93.8
Individual Work	1	5.0	6.3	100.0
Total	16	80.0	100.0	
Missing System	4	20.0		
Total	20	100.0		

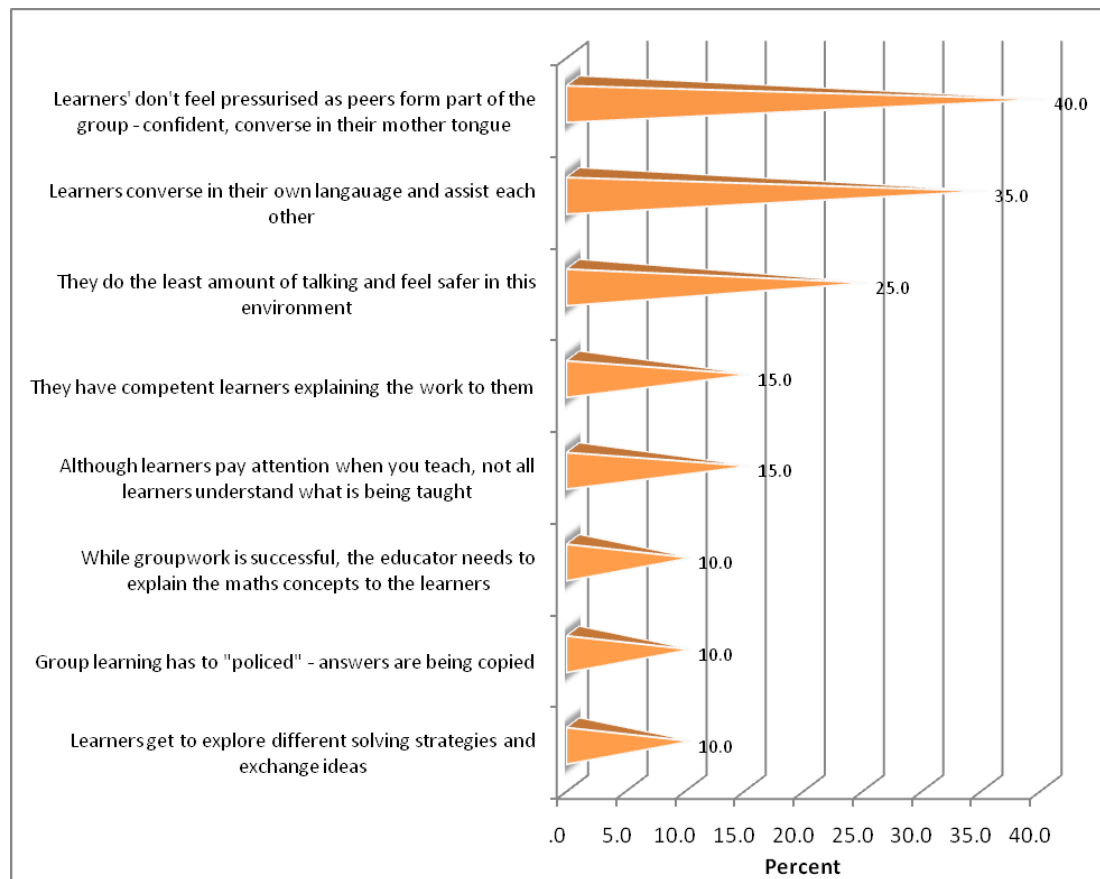
Of these, 75% (see Figure 4.12 overleaf) explained that ESL learners prefer groupwork since they do not feel pressurised in a group discussion; they are confident as they learn in their mother tongue; and they assist each other. Also learners are able to discuss with other group members the solution to the word problem, in their own language and in a non-threatening environment. Educators have obviously used different teaching methods when teaching ESL learners, and have found that ESL learners feel most comfortable learning in a group setting. This was confirmed by learners during the focus group interviews. The majority of learners preferred groupwork for the following reasons:

*“We can come together and discuss. Some can’t count, so we can teach each other.”*

*“If there’s clever children in the group then if we don’t understand we can ask them for help.”*

*“Some questions are difficult, but as a group we can share ideas and stuff and say about how we do this and try different ways to get our answer.”*

Figure 4.12: Learners' Reasons for Choice of Teaching Method



According to Tileston (2004), educators who know their learners well will understand that ESL learners may be embarrassed to speak aloud for fear of being ridiculed. 25% of educators (see Figure 4.12 above) observed that some ESL learners do the least amount of talking and therefore feel safer in the group setting. Group learning will therefore “*have to be policed*” as suggested by 10% of the respondents in order to ensure that all learners are contributing and benefitting from the discussion. 25% of educators indicated that learners were afraid to speak and ask questions mainly because they are unable to articulate themselves well enough. Haynes (2007: 10) explains that it is common for ESL learners to go through a silent period, where they actually get ready to produce oral language. She suggests that educators provide hands-on activities and encourage these learners to initially participate in small-group discussions in order to improve their confidence levels. It is in this atmosphere of mutual trust and co-operation (Elbers, 2003)

that children feel free to express their views and contribute to the lesson (Sridevi and Gohit, 2008).

Question 13 asked the educators whether ESL learners' culture affects the way they solve word problems. 25% reported that when learners of the same culture work together and solve problems incorrectly the educator can easily gauge whether this is due to cultural reasons. 15% of respondents explained that the learners' social environment and its challenges, for example poverty and child-headed families would affect their learning ability. Another 20% added that ESL learners have the ability to solve word problems but language is the actual barrier to solving mathematical problems.

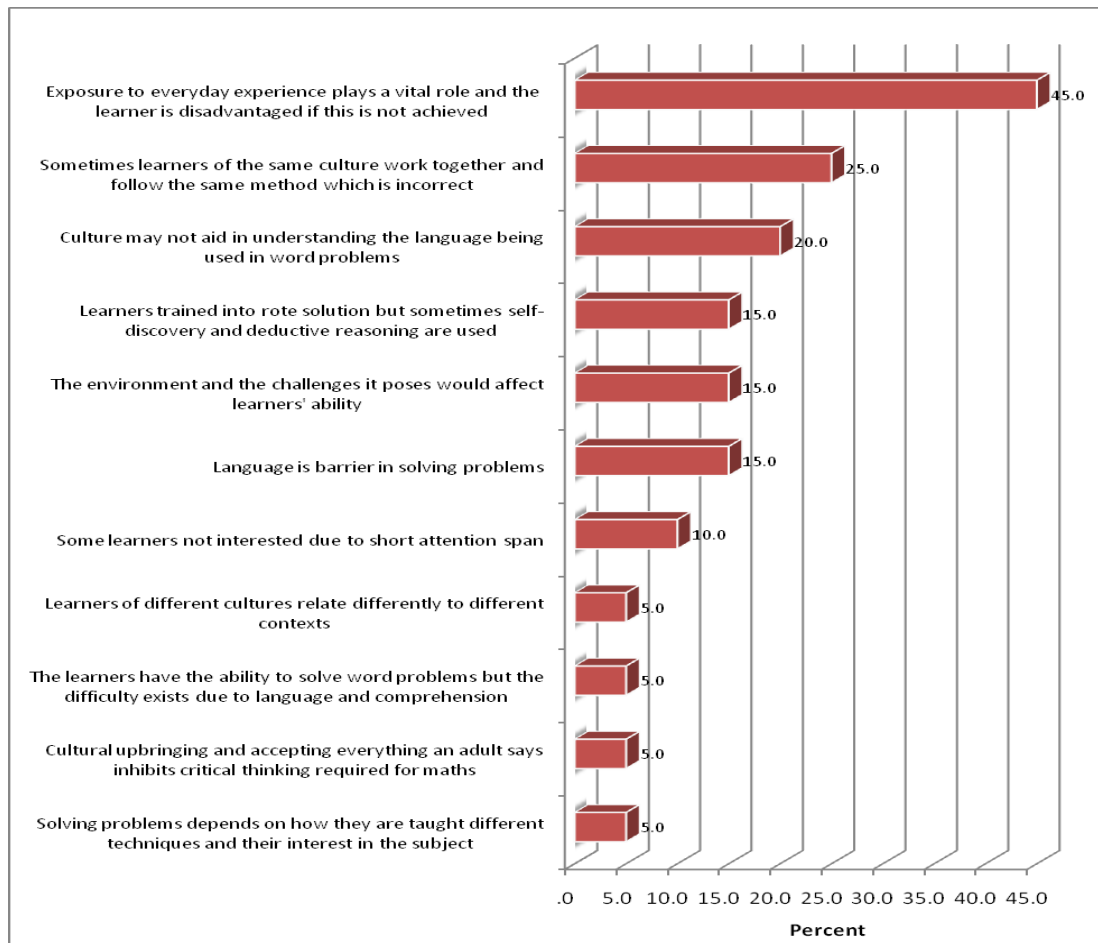
According to Warren, Baturu and Cooper (2010: 167), an area of mathematics that addresses its cultural impact is critical numeracy. He explains further that critical numeracy focuses on the way practical mathematical situations are implicated in learners' everyday experiences. Nickson (2004: 2) adds that learning is a purposeful activity that is necessary for learners' intellectual growth, and the emphasis of teaching and learning in the mathematics classroom should be on learners 'coming to know' things rather than 'coming to do' things.

More than half (55%) of the educators did not think that culture affects the way learners solve word problems. Those who did believe that culture affects the way learners acquire knowledge gave reasons which are captured in Figure 4.13 (on page 114).

45% of respondents indicated that exposure to everyday experiences plays a vital role in learning since the learners are familiar with such scenarios. As a result they tried to incorporate learners' experiences into their lessons. The ways in which this was done is indicated in Figure 4.14 (on page 115).



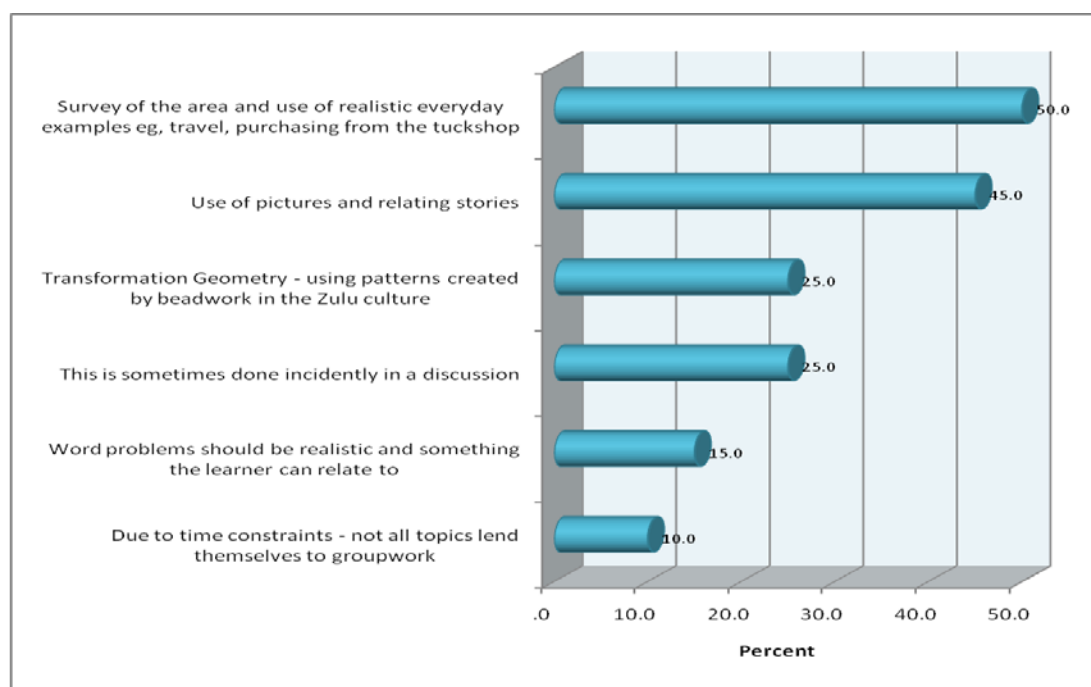
Figure 4.13: The Effect of Culture on Learning



50% of respondents indicated that they made use of realistic everyday examples especially in the teaching of Financial Mathematics. 45% reported using pictures and stories to relate learners' everyday experiences to mathematics. A quarter (25%) of respondents indicated that they made reference to Zulu beadwork patterns in the teaching of Transformation Geometry, while an equal number of respondents (25%) mentioned the indirect use of learners' everyday experiences in classroom discussions.

This view is supported by Von Glasersfeld (1989) who said that children learn best when they are allowed to experience things and reflect on their experiences. Piaget's studies of learning in young children also confirm that children learn by trying out new things and by fitting their results with their

*Figure 4.14: Incorporating Learners' Experiences into the Teaching of Mathematics*



current understanding (Kear, 2010: 11). By so doing, learning potential will be heightened when there is congruency between learners' findings and their personal experiences (Kear, 2010). Tassoni (2006: 117) adds that children learn best when they engage with familiar objects and situations and educators can extend this experience more effectively. The educator is expected to act as a facilitator to help learners discover from their own background knowledge and experiences any new learning that will take place (Richardson, Morgan and Fleener, 2008: 104).

#### **4.5 SUMMARY**

This research study used both qualitative and quantitative methods to gather data about ESL learners' experiences and challenges in the mathematics classroom specifically in the learning of word problems. The findings show that the majority of ESL learners and their mathematics educators experience difficulty in the learning and teaching of mathematics through the medium of English.

It was also found that ESL learners are performing poorly in mathematics word problems due to poor reading and comprehension skills (Haynes, 2007: 64). Educators are therefore adapting their teaching strategies in order to attract learners' attention (Schwartz, 2005: 126) and to develop their knowledge (Killen, 2006: 126) in mathematics.

The next chapter presents the conclusions that arose from the research findings, highlights recommendations for use in the ESL classroom, and makes suggestions for future research.

## CHAPTER FIVE

### CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 INTRODUCTION

The previous chapter analysed the findings of this study, this chapter presents the conclusions and recommendations emanating from the study, and suggestions for future research.

What is the use of teaching the native child mathematics when he can not use it in practice? If the native child inside South Africa today in any of the schools in existence is being taught to expect that he will have his adult life under a policy of equal rights, he is making a big mistake (Verwoerd, 1953: 3585).

The above is an extract from a speech delivered by Dr H.F. Verwoerd, the Minister of Bantu Affairs, on 17 September 1953 in moving the Second Reading of the Bantu Education Act (Abdi, 2002: 40). Verwoerd, who later became the Prime Minister of South Africa, was regarded as the architect of apartheid. The Bantu Education Act gave rise to an inferior education system for African learners that provided them with elementary-level literacy skills (Ball, 2006: 20). Research by Wilkinson (1981: 150) in the 1980s into the poor performance of Grade 7 African learners in four homeland states in South Africa revealed that: learners lacked knowledge of basic mathematical concepts; they struggled with the language barrier; and their examinations did not take their cultural experiences into consideration. South Africa has come a long way since Verwoerdian rule, but sadly, even after the death of Verwoerd and apartheid not much progress has been made with regards to mathematics education. South African learners are still struggling in mathematics and the failure rate is very high (Maree *et al.*, 2006).

According to Motala (2008: 47), post-1994, the South African education system was already fractured by racial inequity and poor quality of education for the majority of learners. In fact Khuzwayo (2005: 310) adds that mathematics education for African learners in South Africa has never been in a healthy state. This was clearly evident in the Third International Mathematics and Science Study (TIMSS) tests which were conducted by the Human Sciences Research Council (HSRC) in South Africa in 1995, 1999 and 2003 to measure Grade 8 learners' competence in mathematics and science (OECD, 2008: 54). It was found that South Africa repeatedly performed poorly, coming last out of 50 participating countries in 2003 (Reddy, 2006). The lowest levels of performance were noted in the former African schools.

The educational progress of "Madiba's children", those learners who began their schooling immediately after the abolition of apartheid, indicates that of the 1 666 980 learners who entered Grade 1 in 1995, 66% dropped out of school before reaching Grade 12 (Yeld, 2010: 176). Proudlock (2009: 306) attributes high drop-out rates in South Africa to the following factors: poverty; the stoppage of the child support grant at the age of 15 years; children staying at home to care for a sick adult; and poor quality of schooling. Another salient factor is English-medium education, which according to Orman (2008: 96) results in poor cognitive proficiency in English, high levels of drop-out, and educational failure among ESL learners.

Post-1994 the new democratic government has opened doors to all those who were disadvantaged in the past by introducing its "Education for all" campaign (Desai, 2006:131), but Brock-Utne (2001) raises a pertinent question: "In whose language?" According to Alexander (2001: 5) the languages of South Africa are situated on a continuum, English being on the most macro or powerful end and the African languages situated at the most micro or powerless end. Cuvelier (2007) notes that despite the equitable

promotion of all 11 languages by the South African government, there is still a tendency towards English monolingualism.

Kamwangamalu (1997: 249) proposes that mother-tongue education might become an alternative to English medium education provided that it is “cleansed” of the stigma it has been carrying since the heydays of apartheid.

In the teaching of mathematics it is necessary to understand the connection between mathematics and the learners who are trying to learn mathematics (Anhalt, Ondrus and Horak, 2007). Teaching word problems in English in a diverse classroom requires the use of problem-solving tasks that are enjoyable, realistic and relevant to the learners’ background, culture and experiences (Kruger and Yorke, 2010: 296). The constructivist learning theory was the theoretical framework that underpinned this study. A central theme in the constructivist learning theory is that learning is an active process in which learners form new ideas based on their current and past knowledge (Bruner, 1966). Van der Walt and Maree (2007: 224) encourage the use of groupwork in the constructivist classroom where learners with different skills and backgrounds collaborate in tasks and discussions in order to arrive at a shared understanding of the truth. The constructivist learning environment requires guided interactions by the educator (Sridevi and Gohit, 2008) that will allow learners to reflect on their mistakes or areas of difficulty and to change their thinking through communication.

The aim of this research study was to identify the challenges experienced by English second language learners and their educators in the learning and teaching of mathematics through the medium of English. Limited proficiency in the English language can pose a barrier to using mathematics effectively as a communication and problem-solving tool (Naude, 2004: 122). Chamot and O’ Malley (1994: 228) found that ESL learners experience a greater degree of difficulty in solving word problems in mathematics. They

explain that learners who experience difficulty understanding the language in which the word problem is expressed will be unable to solve it.

The following were the objectives addressed:

- to identify ways in which second language learners learn mathematics with special emphasis on word problems;
- to identify challenges that mathematics educators and second language learners encounter in the teaching and learning of word problems; and
- to identify strategies that mathematics teachers use to teach word problems to second language learners.

Using a mixed methods approach, that is, a combination of qualitative and quantitative methods, this study focused on the experiences of Grade 8 ESL learners and their mathematics educators at ten secondary schools in the Mafukuzela–Gandhi Circuit. Qualitative research was conducted by means of focus group interviews with learners, and quantitative research was carried out through the administering of questionnaires to educators. Five themes emerged from the analysis of data in this study. The conclusions that arose from these themes are discussed below.

## **5.2 ACHIEVEMENT OF THE OBJECTIVES**

Achievement of the objectives are discussed in terms of the themes presented in Chapter 4.

Theme one explored ESL learners' experiences in the mathematics classroom. There were varied comments regarding ESL learners' experiences in the mathematics classroom, with a small proportion of learners finding mathematics enjoyable and relevant for everyday life. The majority of learners, on the other hand, found mathematics difficult, unenjoyable and demotivating (William *et al.*, 2004: 51). It would seem that

ESL learners struggle to understand what they read and have difficulty expressing themselves in English. This in turn leads to a lowering of their self-esteem and confidence. ESL learners were also using ineffective methods to learn mathematics and to study for tests - they tend to swot mathematics rather than attempt to understand it (Haynes, 2007: 85). Learners reported looking for key words in the text when solving word problems but were often baffled by unfamiliar and difficult words, which prevented them from solving the problem. It became evident that educators were not using a range of activities nor were they providing sufficient additional support to ESL learners who are struggling with mathematics.

Theme two investigated learners' assessment in light of the fact that ESL learners with language difficulties are prone to academic failure. A glaring observation was that educators are spoon-feeding ESL learners (Karp and Howell, 2004), by explaining difficult or confusing words in the mathematics classroom and during class tests. The crunch time is when ESL learners, who have become reliant on their educators for assistance, are forced to fend for themselves during examinations (Murray, 2002: 439). The main challenge in mathematics tests is that many ESL learners are not familiar with English words that carry key information (Marcotte and Hintze, 2009: 79), preventing them from demonstrating their mathematical skills. This points to the need for educators to use a range of activities and effective teaching methods to help ESL learners who were struggling with mathematics. The adaptation of teaching strategies will be discussed later in this section.

The third theme, which is one of the major themes, investigated the effect of the English medium of instruction on ESL learner performance. When the LiEP was developed in 1997 (Mda, 1997), its underlying principle was to retain the learner's home language for learning and teaching and to encourage learners to acquire proficiency in additional languages (Department of Arts and Culture, 2003). African parents were allowed a say



in their childrens' education and in the choice of the medium of instruction to be used at schools (Orman, 2008: 96). A sad reality is that African parents want their children to maintain their home language in order to stay in touch with their cultural roots (Nkabinde, 1997), but choose English-medium schools and English-medium instruction because they associate English with a successful future for their children (Schafer, 2005). Setati (2008: 104) says African parents associate mother-tongue education with oppression, segregation and backwardness. To the contrary, Banda (2004: 30) explains that the main reason African parents send their children to English-medium schools has little to do with negative attitudes to African languages and more to do with better resources, efficient management and an attempt to get a first-class education. Webb (2002: 192) maintains that parents are ill-informed about the LoLT debate. Rather than to pay attention to their own children's needs, African parents are choosing English medium education because this is the choice that politicians and upper class people are making for their children (Brock-Utne, 2002: 38). They do not realise that this is the main reason African learners continue to perform comparatively poorly in academic tasks (Alexander, 2000).

ESL learners who had attended primary schools in the Indian areas where English was the LoLT displayed a fairly good command of the English language (Minow, 2010: 17). It appears that learners attending township schools are frequently exposed to the practice of codeswitching. The issue of codeswitching, although not practised by the majority of educators in this study, was shunned by ESL learners. These learners realise that it is time-consuming for the educator to translate from English to an African language (Fleisch, 2008: 109), and admit it is unfair to the non-African learners. They also indicated they have grown accustomed to being taught through the medium of English in primary school and are not in favour of being taught through an African medium in secondary school. Learners and educators reported that mathematics textbooks and the examinations are written in English, so it would make sense for English to remain the medium of

instruction. 15% of educators and 30% of the ESL learners agreed that greater proficiency in the English language would improve their performance in mathematics.

The findings revealed that ESL learners are experiencing difficulty solving word problems, mainly due to limited proficiency in the English language (Chamot and O' Malley, 1994: 228). ESL learners are faced with the dual task of acquiring English as a second language as well as learning mathematics in English. Their difficulty in mathematics is compounded by poor reading and comprehension skills (Crandall *et al.*, 1985). Theme four, therefore, examined the challenges that ESL learners encounter in solving word problems. The common reasons reported for poor performance in word problems were: poor decoding and comprehension skills due to the language barrier; learners not exposed to word problems in the lower grades; poor reading skills; lack of confidence; and poor literacy skills. Educators reported that even ESL learners who have a good command of the English language, are experiencing difficulty with the academic language used in mathematics (Bahr, Bahr and Degarcia, 2008: 343). Poor understanding of specialized content words and general academic words (Dugan, 2010: 22) prevent ESL learners from demonstrating their mathematical ability in solving word problems.

Many ESL learners are struggling academically due to poor study techniques and a lack of foundation knowledge (Kanjee and Prinsloo, 2005: 20). Their lack of foundation knowledge from primary school has resulted in them not having acquired the necessary problem-solving skills required at grade 8 level. It would seem that blame for learners' poor foundational knowledge is being pointed at different directions: secondary schools blame primary school educators for not laying a strong foundation (Phurutse, 2006: 222), some ESL learners are blaming educators for not explaining concepts adequately, while other learners are blaming themselves for not trying hard enough. Stemming from this is the Department of Education's realisation that many

mathematics educators in South Africa have poor content knowledge and are therefore incapable of teaching effectively (CDE, 2007: 27). In their defence, educators expressed a degree of unpreparedness in working with ESL learners due to cultural and language differences (Kersaint *et al.*, 2008: 58), as well as the absence of developmental workshops and pre-service training.

Theme five explored the need for educators to change or adapt their teaching strategies in order to help ESL learners. Educators indicated that the word problems given in textbooks are often difficult and ESL learners were experiencing difficulty understanding them, therefore they adapted their teaching strategies (Everhart, 2011: 81) in order to expose learners to a variety of situations and to help them build strategies for solving other problems (Griffin *et al.*, 2010: 112). Educators reported using the following methods to help ESL learners: peer learning/teaching; the Polya problem-solving model; highlighting key words and study techniques; using incentives and visual aids. Most of the educators indicated that groupwork was most suitable to the teaching of word problems since group discussion allows ESL learners to learn from other competent learners in their mother tongue (Coggins *et al.*, 2007: 37). ESL learners with different skills actively participate in discussions and arrive at a common understanding (Van der Walt and Maree, 2007: 224). Sadly this method was used less frequently compared to whole class discussion and individual work due to discipline problems, the educators' inability to handle group dynamics and the tendency for learners not to contribute to the group discussion.

Surprisingly ESL learners seemed to think that whole class discussion was most feasible for the teaching of mathematics, mainly because the educator has more control over classroom discipline, and discussion of mathematical problems culminates with the class and the educator together coming up with potential solutions. The learners reported that individual work was also commonly used in the mathematics classroom, this method allowed the educator to walk around, observe and help learners while they work. It was

evident that although group work was most beneficial in the ESL classroom, this method was not used enough. Besides being an enjoyable method, groupwork allows learners with different levels of comprehension and mathematical skills to learn from other group members' experiences (Elbers, 2003) and to progress to a higher level of understanding. 45% of the educators indicated that culture and exposure to everyday experiences plays a vital role in learning and should therefore be incorporated into their lessons.

The limitations of this study will now be discussed.

### **5.3 SOME LIMITATIONS OF THE STUDY**

This study investigated challenges experienced by ESL learners and their educators in the teaching and learning of mathematics word problems in English. As such, this study focused on language ability of the learner, but acknowledged that language ability of the educator also plays a major role in the classroom. An investigation into the effect of the educators' ability in English on learner performance could have yielded richer data, but was outside the scope of this study.

This study could also have been expanded to include an in-depth study of learners' home language; demographic background; family history; educational level of parents and siblings; exposure to technology; and socio-economic background to determine their impact on learners' mathematical ability. Unfortunately, inclusion of the above was not possible within the ambit of this study.

The research sample was limited in terms of the population and the geographic location as the researcher was interested in seeking solutions to challenges that she experiences with her learners. She had to be present to conduct the focus group discussion herself, so the study had to be limited in terms of the population (grade 8 learners) and the geographical location (the

Mafukuzela-Gandhi Circuit in northern KwaZulu-Natal). Any significant results emerging from this study therefore, may not reflect the situation at all schools, but will undoubtedly prove useful in beginning to understand and address the needs of ESL learners studying word problems in mathematics.

## **5.4 RECOMMENDATIONS**

The recommendations below emanate from the research findings and follow from the conclusions presented above.

### **5.4.1 Encouraging and Motivating ESL Learners**

ESL learners who are experiencing difficulty in mathematics lose confidence in themselves and therefore perform poorly. It is important for the educator to make mathematics interesting and enjoyable (Stevens, 2010: 190) by using innovative techniques and a culturally relevant curriculum to get learners' attention (Kersaint *et al.*, 2008: 73). The educator could use multisensory instruction by means of visuals, actions, demonstrations and models to capture learners' attention and engage them in stimulating mathematics (Cruz and Thornton, 2008: 55).

### **5.4.2 Providing Ongoing Support to ESL Learners**

ESL learners become reliant on their educators' assistance during lessons and class tests. During examinations, however, these learners are disadvantaged since educators are not allowed to explain difficult or unfamiliar words (Murray, 2002: 439). There is a need for educators to provide ongoing support to these learners, by discussing the meaning of words as they relate to the content and by describing the different ways in which the words are used in different contexts (Marcotte and Hintze, 2009: 79). Mathematical thinking, mediated by linguistic processes, is a prerequisite for the understanding of mathematics (NCTM, 2007). Mathematics educators

should therefore promote English language development through a natural process in which the focus is not on language only but on the teaching of mathematical concepts and processes (Dale and Cuevas, 1992).

#### **5.4.3 Using Alternative Assessment Strategies**

ESL learners perform poorly in assessments due to limited language proficiency, poor study techniques and time constraints. Educators could develop alternative assessment strategies, for example, giving instructions in the ESL learners' home language; allowing learners to use bilingual dictionaries; teaching learners study techniques and problem-solving skills; increasing the amount of time allocated for tests; and allowing ESL learners to complete their tests after school (Haynes, 2007: 85).

#### **5.4.4 Educating Parents of ESL Learners**

Many linguists agree that mother tongue education in the primary years is useful in the acquisition of English as a second language. The LiEP, which was introduced in 1997, encouraged the use of the mother tongue as the LoLT in the first four years of schooling. This is not the case in schools in South Africa. African parents are choosing English as the medium of instruction for their children because they associate English with a successful future for their children. There is a need for African parents to be educated about the benefits of mother tongue education in the formative years of schooling. The Minister of Basic Education, Minister Angie Motshekga, announced in 2010 that the Schooling 2025 campaign, which will begin in 2012, will address differentiation of educational standards in an attempt to improve the performance of all learners over the following 12 years (DBE, 2010). One of the ways the new curriculum aims to achieve this is to allow African learners the option of learning in their mother tongue for the first three years of their schooling.

#### **5.4.5 Improving Foundational Knowledge**

Educators reported that learners' lack of foundation knowledge from primary school has resulted in learners not having acquired the necessary problem-solving skills required at grade 8 level (Kanjee and Prinsloo, 2005: 20). There should be consistent monitoring of teaching in the primary schools in order to improve results at secondary school level (Phurutse, 2006: 222).

#### **5.4.6 Improving the Quality of Mathematics Educators**

ESL learners have accused educators of having poor content knowledge and of not being able to teach effectively. It is imperative that educators have excellent content and pedagogical knowledge, and their subject content knowledge ought to be at a level 2 to 3 years higher than the level being taught (Ottevanger *et al.*, 2007: 43) so that they will be able to engage learners in high-level conceptual learning (Adler, Slonimsky and Reed, 2002: 136).

#### **5.4.7 Training Educators to Teach in Multilingual Classrooms**

In diverse multilingual classrooms it is becoming difficult for educators to address learners' language needs; maintain discipline and diagnose causes of academic failure. It is necessary for educators to undergo training that will enable them to effectively teach multilingual classes. Uys *et al.* (2007: 78) suggest that the Department of Education as well as teacher training institutions provide development workshops and design appropriate training courses that will prepare subject content educators for multilingual classrooms.

#### **5.4.8 Adapting Teaching Strategies**

As a result of poor reading and comprehension skills, ESL learners are often unable to understand a mathematical word problem; locate the relevant

information; and determine what operations to use to solve it (Reid and Lienemann, 2006: 121). It is therefore necessary for the educator to use a variety of teaching strategies to ensure that ESL learners enjoy success in mathematics (Everhart, 2011: 81). Word problems given in textbooks are often difficult and impractical. Educators ought to choose problems that are relevant and meaningful for ESL learners and expose them to different types of word problems, that will help them build strategies for solving other problems (Griffin *et al.*, 2010: 112). Other strategies that could be used to help, encourage and stimulate learners are: peer learning/teaching; teaching problem-solving skills; breaking the problem into smaller parts; reading the problem aloud; using incentives and visual sources; teaching vocabulary and highlighting study techniques.

#### **5.4.9 Using Groupwork**

ESL learners are generally embarrassed to speak aloud or ask questions for fear of being ridiculed (Tileston, 2004: 53). The educator could use groupwork as a platform for learners to voice their difficulties, to ask questions and to learn from other group members (Coggins *et al.*, 2007: 37). ESL learners have different levels of comprehension and mathematical skills, therefore groupwork allows the weaker learners to learn from other group members (Elbers, 2003). In order for this technique to be successful, the educator plays an important role as facilitator to help learners discover from their own background knowledge and experiences any new learning that will take place (Richardson *et al.*, 2008: 104). When working with large class sizes educators find it difficult to maintain discipline and control group activities. Schwartz (2005: 126) suggests that educators use effective strategies that will attract and hold learners' attention, while Martin and Loomis (2006: 215) proposes that educators engage learners in interesting and meaningful lessons. Active learner participation in terms of the constructivist learning theory may be used as a means of helping mathematics educators to stimulate and motivate ESL learners. It is



envisaged that this approach will foster active participation in lessons and group discussions, thereby increasing learner confidence and aiding in the understanding of English terminology used in maths problems.

## **5.5 SUGGESTIONS FOR FURTHER STUDY**

While this study found that learners' ability in English does affect their performance in mathematics word problems, it also acknowledges that language proficiency is not the only requirement for success in mathematics. Many more questions remain to be answered in order to fully address learners' performance in mathematics, research into mathematics educators: training or education; proficiency in English; attitudes towards the subject; skill in teaching mathematics; knowledge of mathematics; ability to adapt their teaching for different levels or grades; among others could certainly benefit teaching and learning in mathematics.

Borne out of the findings and review of literature, this study recommended the use of groupwork for the teaching of word problems to ESL learners. It would be beneficial therefore to investigate effective group work strategies for the teaching of mathematics word problems to English first and second language learners. Research into South African Grade 8 English first language learners' ability to solve word problems is also necessary since it is not only ESL learners who experience difficulty in mathematics and word problems. Lessons could also be learnt from research into Grade 8 ESL learners who perform well in mathematics word problems.

As the constructivist classroom is shaped by learner participation, research into peer tutoring where 'high achievers' tutor the 'average' or 'low achiever' could assist in developing learners' ability to solve word problems in mathematics. To facilitate effective teaching, the educator must receive continual professional development. Research into the effect of teacher development workshops on teaching in a multilingual classroom, for

example, could make recommendations for continuing professional development for educators.

## **5.6 A FINAL WORD**

In spite of the South African government's bid to protect all languages and promote the different cultures, the education sector still does not totally reflect the multilingual nature of South Africa. The African languages continue to be marginalized, and parents' choice of English as a medium of instruction has resulted in language difficulties for ESL learners. Poor language and comprehension skills, in turn, have impacted negatively on ESL learners' performance in mathematics word problems in particular those problems that require comprehension of specialized content words and general academic words.

In 2011 the African child, and indeed all children in South Africa enjoy equal rights under our democratic constitution, what remains is for all children to have an equal vantage point in education. The present situation, where the majority of African learners are not meeting the criteria to be accepted into the technological and scientific fields (Setati, 2005), indicates there is a crisis. A strong foundation in reading, writing and numerical skills needs to be developed in order to close the large gap created by apartheid education between the quality of education provided for African and white learners (Powell, 2002). Seventeen years into democracy and the ESL learner is still trying to overcome the deficit caused by apartheid education. The learner has equal rights and is using mathematics in practice, but the effect of the medium of instruction on performance in mathematics cannot be ignored. Language is an important resource in teaching and learning mathematics and educators ought to support ESL learners in learning mathematical language with meaning and fluency.

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# APPENDIX A

## PERMISSION FROM DoE TO CONDUCT RESEARCH



kzn education

Department:  
Education  
KWAZULU-NATAL

MRS A POORAN  
281 CANEHAVEN DR  
FORESTHAVEN  
PHOENIX  
DURBAN

Enquiries: Sibusiso Alwar

Date: 26/03/2010

Reference: 0031/2010

### PERMISSION TO INTERVIEW LEARNERS AND EDUCATORS

The above matter refers.

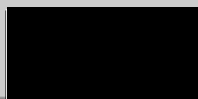
Permission is hereby granted to interview Departmental Officials, learners and educators in selected schools of the Province of KwaZulu-Natal subject to the following conditions:

1. You make all the arrangements concerning your interviews.
2. Educators' programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, educators and schools are not identifiable in any way from the results of the interviews.
5. Your interviews are limited only to targeted schools.
6. A brief summary of the interview content, findings and recommendations is provided to my office.
7. A copy of this letter is submitted to District Managers and principals of schools where the intended interviews are to be conducted.

The KZN Department of education fully supports your commitment to research: Teaching word problems in English to second language grade 8 learners in the Mafukuzela – Gandhi circuit

It is hoped that you will find the above in order.

Best Wishes



R Cassius Lubisi, (PhD)  
Superintendent-General

...dedicated to service and performance  
beyond the call of duty.

KWAZULU-NATAL DEPARTMENT OF EDUCATION

POSTAL : Private Bag X9137, Pietermaritzburg, 3200, KwaZulu-Natal, Republic of South Africa

PHYSICAL: Office C25, 188 Pietermaritz Street, Metropolitan Building, PIETERMARITZBURG 3201

TEL: Tel +27 33 341 8610/8611 | Fax: +27 33 341 8612 | E-mail: [education@kzn.gov.za](mailto:education@kzn.gov.za) / [support@kzn.gov.za](mailto:support@kzn.gov.za)



**kzn education**

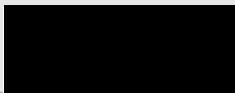
Department:  
Education  
KWAZULU-NATAL

10. The Department receives a copy of the completed report/dissertation/thesis addressed to:

The Director: Resource Planning  
Private Bag X9137  
Pietermaritzburg  
3200

We wish you success in your research.

Kind regards



**R. Cassius Lubisi (PhD)**  
Superintendent-General

...dedicated to service and performance  
beyond the call of duty.

KWAZULU-NATAL DEPARTMENT OF EDUCATION

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## **APPENDIX B**

### **FOCUS GROUP INTERVIEW SCHEDULE**

1. What do you like about maths?
2. What do you not like about maths?
3. What activities do you enjoy in the maths classroom?
  - 3.1. Why do you like these activities?
4. Which of the following ways of learning do you prefer most?
  - a) individual work
  - b) small group work
  - c) whole class discussion
  - 4.1. Why do you prefer this way of learning?
  - 4.2. Why do you not prefer the other two ways of learning?
  - 4.3. Which way of learning does your maths teacher use most often?
5. Do you feel that you are coping with the grade 8 maths?
6. What has contributed to your success/failure in maths?
7. What problems do you experience in maths?

8. Which sections do you find most difficult?
  
9. When faced with a problem in the maths classroom, who do you consult first for help: your teacher, your classmate or your brother/sister? Please give reasons for your answer.
  
10. Do you enjoy solving word problems in maths? Please give reasons for your answer.
  
11. When you experience difficulty solving word problems, what do you do to come up with a solution?
  
12. How do you feel when you are unable to solve a word problem?
  
13. What do you think will help you understand word problems better?
  
14. What language/s do you use at home?
  
15. What other languages can you speak?
  
16. Do you speak English at home? With whom do you speak English?
  
17. Do you use English:
  - a) only at school?
  - b) at home and at school?
  - c) only when you are in shops?
  - d) only when you spend time with friends?

18. Which language do you prefer to be used during your mathematics lessons? Please give reasons for your choice.
19. Do you think you would perform better in mathematics if you had a better understanding of the English language? Please give reasons for your answer.
20. Do you feel that if your teacher could understand and speak isiZulu/isiXhosa, this would benefit you in the mathematics classroom?
21. Please give reasons for your answer in 20 above.
22. What do you like/not like about the way your teacher teaches word problems.
23. Do you have any other comments relating to word problems that I could use in my study?

**Thank you for your time and support**



**APPENDIX C**  
**TEACHER QUESTIONNAIRE**

Please tick where applicable.

**SECTION A : BIOGRAPHICAL DATA**

1. Your age :

**20 – 30** [ ]

**31 – 40** [ ]

**41 – 50** [ ]

**51 – 60** [ ]

**> 60** [ ]

2. Your gender:

**Male** [ ]

**Female** [ ]

3. Grades that you teach :

**8** [ ]

**9** [ ]

**10** [ ]

**11** [ ]

**12** [ ]

4. Number of years you have been teaching mathematics :

**01 – 10** [ ]

**11 – 20** [ ]

**21 – 30** [ ]

**> 30** [ ]

5. Languages you can speak :

**English** [ ]

**Afrikaans** [ ]

**isiZulu** [ ]

**isiXhosa** [ ]

**Other** [ ]

If other, please specify \_\_\_\_\_

**SECTION B : DEMOGRAPHICS OF THE SCHOOL**

6. What is the racial composition of your grade 8 mathematics class/es?

<b>Race group</b>	<b>Percentage</b>
<b>Black</b>	
<b>Indian</b>	
<b>Coloured</b>	

7. In your view, what percentage of learners in your grade 8 mathematics class/es are fully conversant in English?

**0 – 25 %** [ ]

**26 – 50 %** [ ]

**51 – 75 %** [ ]

**76 – 100 %** [ ]

8. From your interaction with learners in your grade 8 maths class/es, what percentage of your class/es is made up of learners for whom English is a second language?

**0 – 25 %**            [ ]

**26 – 50 %**           [ ]

**51 – 75 %**           [ ]

**76 – 100 %**        [ ]

**SECTION C : MATHEMATICS AND LANGUAGE**

9. How would you describe the performance of second language speakers of English in your mathematics classes?

**Weak**                [ ]

**Average**           [ ]

**Good**                [ ]

**Excellent**         [ ]

9.1. Please give reasons for your answer in 9 above.

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10. Based on your teaching experience, how do grade 8 second language speakers of English fare in the section on word problems?

**Weak**                [ ]

**Average**           [ ]

**Good**                [ ]

**Excellent**         [ ]

10.1. Please give reasons for your answer in 10 above.

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11. Have you had to change or adapt your teaching strategies when teaching word problems to second language learners?

**Yes**   

**No**   

11.1. If yes, please explain why you had to change your teaching strategies?

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11.2. What strategies have you used?

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11.3. Briefly explain whether the change in teaching strategies was successful or not.

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12. How often do you use the following teaching methods in your classroom?

	<b>Sometimes</b>	<b>Never</b>	<b>Often</b>	<b>Always</b>
<b>Individual work</b>				
<b>Group discussion</b>				
<b>Whole class teaching</b>				

12.1. Which method do you find most suitable for teaching word problems?

**Individual work**            [ ]

**Group discussion**        [ ]

**Whole class teaching**    [ ]

12.2. Please explain your answer.

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13. Which teaching method/s do you find second language speakers of English enjoy?

**Individual**                [ ]

**Group discussion**        [ ]

**Whole class teaching**    [ ]

13.1. Why do you think they enjoy this teaching method/s?

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14. Do you think learners' culture affects the way they solve word problems?

**Yes** [ ]

**No** [ ]

14.1. Briefly explain your answer.

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15. Do you make use of learners' everyday experiences when teaching mathematics to second language speakers of English?

**Yes** [ ]

**No** [ ]

15.1. If yes, please explain how you do this.

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15.2. Briefly explain whether this has been successful or not.

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**SECTION D : CURRICULUM**

16. Do you think that the grade 8 mathematics curriculum caters for the cultural differences of learners?

**Yes** [ ]

**No** [ ]

16.1. If yes, please describe how the curriculum achieves this.

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16.2. If no, please explain how the curriculum falls short of what is expected.

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17. Do you think that the grade 8 mathematics curriculum caters for the language differences amongst learners?

**Yes** [ ]

**No** [ ]

17.1. If yes, please describe how the curriculum achieves this.

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17.2. If no, please explain how the curriculum falls short of what is expected.

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17.3. In your opinion, what should be done to change the present grade 8 mathematics curriculum to cater for second language speakers of English?

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18. Please indicate whether you speak, read and/or write in isiZulu/isiXhosa?

	<b>Speak</b>	<b>Read</b>	<b>Write</b>
<b>isiZulu</b>			
<b>isiXhosa</b>			

18.1. If you are able to speak in isiZulu or isiXhosa, how has this helped you in teaching mathematics to second language speakers of English?

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18.2. If not, what difference do you think it would make to your teaching if you were able to speak isiZulu/isiXhosa?

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19. Describe an experience you've had in teaching second language speakers of English that has now 'opened your eyes' to the way these learners learn mathematics or solve word problems.

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20. Please add any other comment/s you would like to make on teaching mathematics to second language speakers of English.

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**Thank you for your time and support.**

**APPENDIX D**  
**EDUCATOR COVERING LETTER AND CONSENT FORM**

20 July 2010

Dear Participant

I am studying towards an MTech Degree in Language Practice at the Durban University of Technology. The title of my research is: Teaching word problems in English to second language grade 8 learners in the Mafukuzela – Gandhi circuit.

Please complete the attached questionnaire to enable me to gather data for my research. The information you provide will be kept strictly confidential. Only my research supervisor and I will have access to the completed questionnaires. Please be assured that you will remain completely anonymous throughout the research process and in any reporting or write-ups related to my research.

Please read and sign the attached Consent Form. Please return the Consent Form and completed questionnaire to Mrs A. Pooran at the address below.

Thank you very much.

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Mrs A. Pooran  
Student no : 20934395  
Temple Valley Secondary School  
Pakco Street  
Temple Valley  
Verulam  
Tel. No. : (W) 032 5331734  
(Cell) 0837955357  
(email) : apooran@telkomsa.net

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Prof. P Singh  
Research Supervisor

## **LETTER OF CONSENT**

Dear Participant

Thank you for agreeing to participate in this research study entitled : *The use of adapted teaching strategies in teaching word problems to second language Grade 8 Mathematics learners in the Mafukuzela-Gandhi circuit.*

The poor performance of South African learners in the 1995 and 1999 Third International Mathematics and Science Study (TMSS) is largely ascribed to the problem that learners and educators have in studying and teaching through English as a second or even third language. Second language learners who are already experiencing difficulty in understanding the English language may be unable to develop skills to solve word problems since Mathematics is being taught to them through the medium of English. This study will investigate the language difficulties of second language Mathematics learners, and how Mathematics teachers can adapt their teaching strategies to teach word problems to second language learners.

This study will provide a framework for educators to implement in the teaching of Mathematics at Grade 8 level. It is hoped that the findings of this research will make recommendations to the Department of Education with regards to the teaching of Mathematics to second language learners using adapted teaching strategies.

The researcher undertakes to assure you of the following:

- to maintain your confidentiality;
- to protect your rights and welfare ie. to ensure that no harm comes to you as a result of your participation in this research;
- to present information and transcripts used in this research in such a way as to maintain your dignity, and if in doubt to first consult with you;

- to make available to you the final copy of this research publication;
- you are free to withdraw from this research at any time, if the need should arise;
- no manipulation or withholding of information is involved in this study

Thank you for volunteering to add to a body of knowledge in Mathematics education.

Yours sincerely

\_\_\_\_\_

A. Pooran

MTech : Language Practice

Student No : 20934395

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I, \_\_\_\_\_ (participant's name), agree to participate in this study.

\_\_\_\_\_

Participant's signature

\_\_\_\_\_

Date

## **APPENDIX E**

### **LEARNER COVERING LETTER AND CONSENT FORM**

Dear Grade 8 learner

Thank you for agreeing to participate in this research study entitled : *The use of adapted teaching strategies in teaching word problems to second language Grade 8 Mathematics learners in the Mafukuzela-Gandhi circuit.*

South African learners performed very poorly in the 1995 and 1999 Third International Mathematics and Science Study (TMSS). This is largely due to the problem that learners and educators have in studying and teaching through English as a second or even third language. Second language learners of English who are already experiencing difficulty in understanding the English language may be unable to develop skills to solve word problems since Mathematics is being taught to them through the medium of English. This study will investigate the language difficulties of second language Mathematics learners, and how Mathematics teachers can adapt their teaching strategies to teach word problems to second language learners.

This study will provide a framework for educators to implement in the teaching of Mathematics at Grade 8 level and will help educators to adapt their teaching methods when teaching second language learners of English.

The researcher undertakes to assure you of the following:

- to maintain your confidentiality
- to protect your rights and welfare ie. to ensure that no harm comes to you as a result of your participation in this research
- to present information and transcripts used in this research in such a way as to maintain your dignity, and if in doubt to first consult with you; and
- to make available to you the final copy of this research publication

You are free to withdraw from this research at any time, if the need should arise. No manipulation or withholding of information is involved in this study

Thank you for volunteering to add to a body of knowledge in Mathematics education.

Yours sincerely

\_\_\_\_\_  
A. Pooran  
MTech : Language Practice  
Student No : 20934395

I, \_\_\_\_\_ (participant's name), agree to participate in this study.

\_\_\_\_\_  
Participant's signature

\_\_\_\_\_  
Date