

**EXPLORING THE FACTORS THAT AFFECT ACADEMIC ACHIEVEMENT IN GRADE 6  
MATHEMATICS CLASSROOMS: A CASE OF SOLVING WORD PROBLEMS**

By

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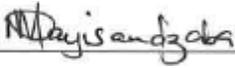
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## DECLARATION

I Nothile Abrijard Tivelele Kunene, declare that this research report, titled

**“Exploring the Factors that Affect Academic Achievement in Grade 6 Mathematics Classrooms: A Case of Solving Word Problems”**

submitted for examination purposes, is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.



SIGNATURE  
(Mrs N. A. T. Kunene)

28 November 2014  
DATE

## ACKNOWLEDGMENT

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### CONCEPT CLARIFICATION

- (a) ANA: Annual National Assessment
- (b) CAPS: Curriculum Assessment Policy Statement
- (c) CCC: memorisation technique of **cover, copy and compare**
- (d) CLD: culturally and linguistically diverse
- (e) ELLs: English Language Learners
- (f) OECD: Organisation for Economic Cooperation and Development
- (g) KZN: KwaZulu Natal
- (h) NCTM: National Council of Teachers of Mathematics
- (i) NR: No reaction
- (j) NRP: Not Ready to Progress
- (k) LoLT: English language as a language of learning and teaching
- (l) OR: Other reaction
- (m) R: Respondent
- (n) RR: Realistic reaction
- (o) SFS: Sinaye Full Service
- (p) SMT: School Management Team
- (q) WPTs: Word problem tasks.

## ABSTRACT

The study explored factors that affect academic achievements in Grade 6 mathematics classrooms in a case of solving word problems. It investigated empirically the causes and perceptions that lead to difficulties in solving word problems and eventually identified strategies for teaching them. The constructivist philosophy was adopted. The study used the mixed-method design with quantitative data complementing the qualitative information. In gathering data, a word problem task, questionnaires, a class observation schedule, face-to-face and focus group interviews were used, focusing on SFS (pseudo) school learners and their teachers as a convenient sample. Data analysis was done in an integrated fashion where concurrent triangulation was followed. The statistics results illustrate that factors such as English language proficiency adversely affect the academic achievements of Grade 6 learners when solving word problems. Reading instructions aloud repeatedly and explaining key mathematical concepts have emerged as key strategies in understanding and solving word problems in mathematics.

### **Key Words**

Mathematics achievement; academic performance; Grade 6 learners; teaching strategies; learners' background factors; teaching factors; solving word problems; word problems task; learners' errors; assessment; problem solving; learners' difficulties.

# CHAPTER 1

## INTRODUCTION AND OVERVIEW

### 1.1 INTRODUCTION

In a Grade 6 Annual National Assessment (ANA) results report by the Department of Basic Education (DBE) (2011), solving word problems was the most difficult skill experienced by learners. In this report, learners attained a 9% mark nationally in word solving problems. In general, the skill of solving word problems requires learners to identify the problem and find functions that link several entities.

The academic performance of learners in mathematics has been poor in schools within the Richards Bay Ward in KwaZulu-Natal (KZN) for over a decade of my experience, and in particular, the participating school at the research site. The analysis of Grade 6 results prompted the implementation of strategies to turn around the situation in these schools. However, the learners' academic performances have not improved to date. It is against this background that this study sought to explore the factors that affect academic achievements in Grade 6 mathematics classrooms within the contexts of real-life word problem solving.

### 1.2 CONTEXT AND BACKGROUND

According to the annual systemic assessment implemented by the Department of Education: in the (ANA) in 2011, the performance results of the school at the research site obtaining a pass percentage rate of 0.45% in 2011 and in 2012 it obtained 0.46 %. This was only a 0.01% increase which showed the necessity to find as much information as possible to alleviate the situation. The Annual National Assessment (ANA) is a systemic evaluation conducted yearly in Grades 3, 6 and 9. The Progression Requirement, as per the Department of Education; Foundation and Intermediate Phases CAPS Orientation (2012) stipulates that in a primary school with specific reference to the Foundation and Intermediate Phase, a learner must attain a minimum mark of Key (40 %) in mathematics in order for him or her to progress to the next class. This implies that a failure to secure key three in mathematics means that the learner will not be able to progress to the next level.

Jan and Rodrigues (2012) argued that further research should be undertaken to determine which factors influence students' ability to comprehend word problems, in order to find the best learning strategies for solving word problems meaningfully. The Department of Basic Education (DBE) was concerned about the poor learner performance in mathematics, more especially regarding solving word problems (The KwaZulu-Natal (KZN) Department of Education, 2012). Learners' work revealed that the poor performances appeared to be due to the difficulties they experienced when answering word problems. In discussions with fellow teachers who taught mathematics in the Intermediate phase, issues of word problem solving seemed to be a main cause of poor performances in Grade 6 mathematics.

Factors affecting the academic achievements of Grade 6 mathematics learners in solving word problems appeared mainly to be manifested, amongst others, through the baseline assessment, formative, systemic and evaluative assessment. The Kwazulu-Natal (KZN) DoE, 2012.) stated that:

Learners have serious conceptual difficulties in solving various types of word problems. As a result a large percentage of learners provide incorrect solutions to word problems (especially those related to both Learning Outcomes (LO 1 and 4) (p.1).

Moreover, the analysis of learner performance in the Standardized Assessment Tasks reported that learners who responded incorrectly to most of the tasks, did not attempt some of the word problem questions in the 2005 provincial Comparative Study (n.d.:3). It was imperative for the researcher to investigate the phenomenon under study as solving word problems is part and parcel of every balanced assessment. Poor performance in solving word problems spells out a poor performance overall that often leads to learners not progressing to the next grade.

### **1.3 SIGNIFICANCE OF THE STUDY**

According to Macmillan and Schumacher (2010), educational research is very important in teaching and learning processes as “educators are constantly trying to understand educational processes and must make professional decisions” (p. 3). Thus this study was aimed at improving the educational practices towards creating conducive teaching and learning platforms in teaching and learning mathematical skills needed in solving word problems. The study also intended to recommend effective pedagogical strategies that could be used by teachers to reduce and remedy the number of mathematical errors committed by Grade 6 learners in solving word problems as they are of the utmost importance in curbing the negative effects on the learners’ academic performance. The potential significance of this research is to provide the policy designers with empirical evidence obtained from a broader understanding of the factors that affect academic achievements of Grade 6 mathematics learners in solving word problems. Mathematics is a subject recognised as the mother of all learning and is essential in almost every field; handling of money, measurements in fashion angles in sports and as a consequence of a good performance in the subject, is important.

### **1.4 STATEMENT OF THE PROBLEM**

The study was necessary because mathematics is one of the subjects in which, when one fails to obtain a moderate achievement mark (Key) of 40 %, he or she is not ready to progress (NRP) to the next grade (DBE, 2011). In spite of the continuous assessment which includes the other forms of assessment such as the assignment, research and end-of-term test, learners had still not been able to reach the expected minimum level 3 which is 40%. In my experience in teaching mathematics in Grade 6, I observed that learners did not achieve at expected levels in mathematics when solving word problems and this leads to learners not progressing to the next grade.

## **1.5 THE RESEARCH QUESTIONS**

The proposed study sought to investigate the following main research questions:

1. What are the factors that affect learners' poor academic achievement in Grade 6 mathematics word problems?

Emanating from the main research question, I used the following sub-questions to assist me in answering the main research question:

- i. How do learners solve word problems?
- ii. What are the learners' problem-solving abilities?
- iii. What teaching strategies do teachers employ when teaching word problems?

## **1.6 THE OBJECTIVES OF THE STUDY**

The purpose of this study was to:

- a) Explore and understand the factors associated with poor academic achievements in Grade 6 regarding to solving mathematical word problems.
- b) Investigate the causes that lead to difficulties in solving word problems in Grade 6.
- c) Identify strategies for teaching word-problem solving.

## **1.7 LITERATURE REVIEW**

Literature confirms that word-problem solving is a worldwide problem. According to the United States Department of Education (U.S DoE), (2004), "In 2003, U. S. performance in mathematics literacy and problem solving was lower than the average performance for most Organisation for Economic Cooperation and Development (OECD) countries..." (p. iii) Similarly, Krick-Morales (2006) asserts that many of the English Language Learners (ELLs) experience difficulties in word problems in mathematics. The difficulties experienced are that learners have to read and comprehend the text of the problem, identify the question that needs to be answered, and finally create and solve a numerical equation. The concern on the quality of teaching and learning mathematics has also been posed as one of the major challenges and concerns of educators by Saritas and Akdemir (2009).

It is stated in Steele (2002:p. 140) that learners struggle even more than usual with word problems and new concepts and frequently "shut down" mentally when they see word problems because they associate these tasks with failure. The combination of reading, writing, reasoning, and mathematical skills required by word problems can make them extremely complex (Steele, 2002). These learners find difficulty in organizational issues more particular in selecting and using appropriate strategies such as regrouping which they then apply it to all problems even when the strategy is not called for. The above author further argues that learners' failure leads to loss of motivation which results in carelessness and inattention problems in solving word problems. They tend to have trouble in listening to all directions, doing all the steps in a problem and completing all the work which leads to mathematical skills difficult to master.

On another note, Aksu (2001) argues that learners' performance declines significantly in all four operations when the operations are presented in the form of word problems with the greatest decline being in the multiplication operation.

## **1.8 RESEARCH DESIGN AND METHODOLOGY**

A research design refers to the general plan in terms of the approach and design of the study, and what methods of data collection are used (Landsberg, 2011). Babbie and Mouton (2001) define a research design as "the road map or blueprint according to which one intends to conduct a research and achieve his research goals and objectives" (p. 279). The definition above qualifies the research methodology subtopic to be crucial. This section provides an overview of the proposed research methodology, discusses the research approach and design, sampling strategies, and data collection strategies as well as data analysis for the purposes of the study proposed here.

### **1.8.1 Research Methodology**

In this study I used mainly a pragmatic research method underpinning the mixed-methods approach as I worked with quantitative data complementing the qualitative information. The data collected was triangulated with the aim of providing reliable data gathering in the study.

### **1.8.2 Research Design**

The concurrent triangulation design was used and the focus was on one primary school, using Grade 6 mathematics learners and two Grade 6 mathematics teachers as a convenience sample. According to Macmillan and Schumacher (2010), concurrent triangulation simultaneously gathers data quantitatively and qualitatively, and merges both methodologies in data analysis and interpretation of data for better understanding of a phenomenon of interest. I used the Grade 6 mathematics assessment record books to identify the 30 worst performed learners in Term one work, which was ten 10 % of the 300 learners in Grade 6 classes. A Test consisting of six word problem tasks (WPTs) was administered to 30 purposely selected Grade 6 learners. The test results assisted me in better understanding learners' ways of solving problems and in measuring their problem solving abilities. The six WPTs were selected from a range of Annual National Assessment (ANA) previous tasks and all the selected tasks were in line with the standards of the Grade 6 curriculum with localised contexts. The selected WPTs formed part of the topics already covered by their work schedule in the current academic year, which meant that WPTs were familiar to the participating learners. Learners were allowed to work individually so that I could measure individual learners' performances. I marked the 30 scripts and analysed the errors made by the learners and identified patterns of approaches or strategies that could be employed during the problem-solving process, as well as how WPTs were solved. This provided quantitative information of how they performed and it informed my subsequent qualitative technique of a focus group that was conducted with a convenience sample of eight learners from a sample of 30 that wrote a test.

The focus group assisted me to gather the qualitative data at learner level. The focus group data enabled me to make sense of the factors that affected academic achievements in Grade 6 classrooms in word problem solving, and the reasoning behind solving the WPTs the way they did in order to identify possible challenges, alternative conceptions and errors made during word problem solving. Macmillan and Schumacher (2010) suggest that a focus group is designed to obtain maximum perceptions on a defined area of interest in a carefully planned discussion where the environment is non-threatening and permissive. In addition, another set of qualitative information was gathered from two mathematics teachers through a face-to-face individual semi-structured interview that covered issues of pedagogy and instructional practices in their classrooms when they taught topics related to word problems. Furthermore, the interview data provided an indication of their abilities to teach mathematics through problem solving. In order to triangulate the data obtained at teacher and learner levels, a questionnaire was administered to the learners in order to further confirm the findings that were established by means of the earlier mentioned data collection strategies.

## **1.9 ETHICAL CONSIDERATIONS**

Bogdan and Biklen (2007) argue that official guidelines of ethics in this research are to ensure that participants enter research projects voluntarily, understanding the nature of the study and the obligations that are involved. Informants should not be exposed to risks that are greater than the gains they might derive.

Permission to carry out the research in one of the primary schools identified in the Richards Bay ward was requested from the KZN Department of Education and the school. I requested permission from the principal to work with the two mathematics teachers in the study and also requested the teachers themselves. I also obtained consent from the parents to work with their children in the study.

I employed the following strategies to support the ethical approaches to fieldwork:

- a) I let the participants know that participation is voluntary and withdrawal without reprisal is accepted.
- b) I honoured the participants' privacy.
- c) Unless otherwise agreed to, the informants' identities were protected so that the information I collected did not embarrass or in any way harm them.
- d) I treated the informants with respect and sought their cooperation in the research.
- e) In negotiating permission to do the study, I made it clear to those with whom I negotiate what the terms of the agreement were, and I abided by that contract.
- f) I told the truth when I wrote up and reported findings (Bogdan & Biklen, 2007, p. 49-50; Saritas & Akdemir, 2009).

## **1.10 CHAPTER SUMMARY AND REPORT OUTLINE**

### **1.10.1 Report Outline**

The research results were presented in this dissertation in the following way:

#### **Chapter 1: Introduction and overview**

This chapter provided an overview of the rationale of conducting the study. The background and context, the statement of the problem investigated the objectives, the research questions as well as the significance of the study were presented in this chapter. Also outlined were the research methodology, the research design, literature review as well as the ethical considerations.

#### **Chapter 2: Literature review and the theoretical framework**

This chapter provides a review of literature relevant to the study as well as theories underpinning the study. This covered the causes and perceptions that led to difficulties in the learning and teaching of word problem solving and strategies to improve the situation.

#### **Chapter 3: Research methodology**

This chapter focused on the discussion of the research methodology, research design and data collection techniques. It covered the mixed method research approach, the current triangulation design, sampling strategies; purposive sampling and convenience sampling. The instrumentation; test, focus group interviews, face-to-face individual interviews and questionnaires were conducted to teachers and learners in the exploration.

#### **Chapter 4: Results and discussions (data analysis and interpretation)**

This chapter presented the data analysis methods and interpretation of the data framed by both literature and theories discussed in Chapter 2. Descriptive statistics forms such as the percentages, frequency distribution of scores, histogram of scores and the frequency polygons were presented.

#### **Chapter 5: Conclusion and recommendations of the study**

This chapter gives all the conclusions from the results based on the findings. Recommendations were also discussed within a framework of the main research question of the study.

## 1.11 CHAPTER SUMMARY

This chapter sought to provide an introduction and overview of the rationale of exploring the factors that affect the academic achievements of learners in Grade 6 mathematics in the case of word problem solving. It highlighted the Department of Basic Education's (DBE) concern on the poor learner performance in mathematics, more especially where it referred to solving word problems in the ANA. Therefore the study aimed at investigating the causes that lead to difficulties in solving word problems in Grade 6 and identify strategies for teaching word problem solving. It would be of great significance to provide the policy designers with empirical evidence obtained from a broader understanding of the factors that affect academic achievement in Grade 6 mathematics learners in solving word problems obtained through this research study. Also outlined is the research methodology, the research design where the concurrent triangulation design was used and the focus was on one primary school, using 8 Grade 6 mathematics learners and two Grade 6 mathematics teachers. The mixed-methods approach was underpinned by the pragmatist research paradigm as quantitative data complemented the qualitative information. The results of the study concurred with literature from authors such as Krick-Morales (2006) who asserted that many English Language Learners (ELLs) experience difficulties in word problems in mathematics. Official guidelines regarding ethics were highlighted to ensure that the study adhered to the ethical requirements and considerations. The intended report outline had been drawn. Chapter Two discusses the review of literature relevant to the study as well as theories underpinning the study. This covered the causes and perceptions that led to difficulties in the learning and teaching of word problem solving and strategies to improve the situation.

## CHAPTER 2

### LITERATURE REVIEW AND THE THEORETICAL FRAMEWORK

#### 2.1 INTRODUCTION

This chapter provides an overview of literature on issues that relate to both mathematic achievement and word problem solving within the contexts of teaching and learning mathematics in senior primary schools, in grade 6. In this chapter, issues of what constitutes word problems, word problem solving as well as the nature of errors made by learners in processes of learning and teaching are discussed. Furthermore, the notion of classroom practices is presented in relation to factors that are associated with academic performances (or lack thereof) of learners within mathematical tasks embedded with story lines and/or words. Then, the chapter concludes by providing a summary of theories discussed within the context of word problem solving.

#### 2.2 WHAT CONSTITUTES WORD PROBLEM SOLVING IN A MATHEMATICS CLASSROOM?

Word problems form part of the South African mathematics curriculum and are used as a vehicle to teach learners how to model problems in primary mathematics classrooms (Sepeng, 2014). A review of what it means to solve mathematical word problems within South African classroom contexts formed part of recent reports from studies that explored learners' abilities in solving word problems (see for example Sepeng, 2013a; 2013b; 2014). Such studies were done in relation to other studies elsewhere in the world (e.g., Nesher, 1988; Jamison, 2000). These researchers agreed that solving word problems in mathematics is part of a unit of the text comprising a question and a speech that is accompanied by an authentic background story and the syntactical and rhetorical structure needs to be explicitly clear to enhance understanding. Other scholars such as Pape and Wang (2003) alluded to the idea that problem solving begins when the solver reads the problem text for the solution process that leads to success as the schemas for problems are activated. In a report presented by the United States Department of Education (2004), problem solving is defined as:

...an individual's capacity to use cognitive processes to confront and resolve real, cross-disciplinary situations where the solution is not immediately obvious, and where the literacy domains or curricular areas that might be applicable are not within a single domain of mathematics, science, or reading (p. 22).

Kenneth (1992) defined word problem solving as a process by which the learners experience the power and the usefulness of mathematics in the world around us. According to Kenneth, word problems are sometimes called *story problems* or *verbal problems*. It is also stated that problem solving was identified by the National Council of Teachers of Mathematics (NCTM) in the 1980s as a priority and a cornerstone for mathematics instruction and a fact that it needed to be a focus of mathematics teaching and learning processes (Xin, 2007). Kenneth (1992) pointed out that word problems provide a context through which learners practice the algorithms and apply the formulas which they are learning.

Jimenez and Espinel (2002) argued that word problems are a classification of a function of semantic structure that is change, combine, compare and equalize. In understanding the structure of the expression problem-solving skills one has to take into account the identity of the unknown quantity. According to Jimenez and Garcia, in the *change* problem, there is an increase or decrease in the initial quantity, for example, “Antonio had 18 stickers. His friend Paco gave him 6 more stickers. How many stickers does Antonio have altogether?” Combine problems consist of a static relationship among a particular set and its two disjoint subsets, for example, “There are twelve sheep in a van, four are black and the rest are white. How many white sheep are there?” Compare problems involve static relationship with a comparison of two distinct, disjoint sets, such as, “Oscar’s bicycle has 14 gears and Anita’s bicycle has 9 gears. How many fewer gears does Anita’s bicycle have than Oscar’s?” Lastly, the equalise problems are based upon comparison of two disjoints, for example, “My dress has 12 buttons. If my sister’s dress has 5 buttons more, it will have the same number of buttons as my dress. How many buttons does my sister’s dress have?” (p. 114).

Ilany and Margolin (2010) further stated that a word problem in mathematics is said to be an independent unit that comprises a speech event and a question sentence which is divided into two types according to the topics they relate to. There are the mathematical word problems that deal with mathematical relationships between objective sizes and those that deal with real life situations (Ilany & Margolin, 2010). Lave (1993: 89) on the other hand, described word problems as a school activity that has “no intuitive connections with everyday experience” (Conrad & Serlin, 2006). Reikeras (2009) alluded to solving word problems as calculation tasks that are embedded in text and whose words and structure create problems that are called word problems. Solving word problems involves calculation tasks that are embedded in the text and whose words and structure create problems that are called word problems. Solving word problems is a process by which the learners experience the power and the usefulness of mathematics in the world around us.

### **2.3 FACTORS THAT AFFECT LEARNERS’ MATHEMATICS ACADEMIC ACHIEVEMENT**

The factors that influence learners’ academic achievement, preventing them from reaching the expected levels when solving word problems in mathematics classes has been widely researched. Improving the mathematics achievement of all learners is a national priority (Hodge, Riccomini, Buford & Herbst, 2006). Saritas and Akdemir (2009) pointed out that achievement in mathematics had been a general concern for all the teachers for the last 20 years (p. 1). These factors cover issues associated with health and behaviour, learners’ intelligence and memory, auditory factors, linguistic diversity, school level factors, social, emotional and behavioural expectations, learners’ conceptions and perceptions, motivation and organisational issues and teacher level factors. South African (SA) authors such as Sepeng (2013) suggested that the factors that have an effect on learners’ mathematics academic achievement when solving word problems include personal characteristics, motivation, race, gender, student intelligence, home language, self-esteem and self-efficacy, academic expectations and effort as well as family education values, expectations and support (p. 628).

### **2.3.1 Issues associated with health and behaviour in learning mathematics**

Issues that are associated with health and behavioural factors impede the academic achievement of learners in mathematics. Loder-Symonds (2012) suggests that learners with dyscalculia experience mathematical learning difficulties. The learners do not know the difference that involves different quantities such as a container with 50 sweets in it and a container with 500 sweets in it. This implies that the learning and understanding of the correct mathematical language is crucial as he compares mathematics to a language. The correct terminology and definitions of the terms should be encompassed in the teaching and learning process. This is alluded to by Tucker (n.d) who believes that dyscalculia is one of the more serious mathematical disorders that learners encounter which can only be assessed by a psychologist or learning specialist who is skilled in finding, by persistent investigation, the differences between intellectual ability and academic achievement.

Hodge, Riccomini, Buford and Herbst (2006) argued that externalising behaviours such as aggression and delinquency negatively affects learners, especially those with emotional and behavioural disorders (EBD) in several content areas including mathematics. As a worldwide problem that has an effect on gender, literature confirms that "...females outscored their male peers in problem solving in six of the seven remaining participating countries" (United States Department of Education 2004, p.iv).

Hilton (1986) cited in Jamison (2000) stated that:

Mathematics cannot be learned without being understood - It is not a matter of formulae being committed to memory but of acquiring a capacity for systematic thought (p. 48).

Systematic thought is not all about reducing everything to symbols and equations but also to express yourself verbally in a precise way and learning definitions. A definition must have a clear genus and a clear stated species and it must be written as a complete, grammatically correct English sentence such as the definition of a rectangle which is a quadrilateral whose four angles are all right angles (a good definition) compared to; a rectangle is a quadrilateral with right angles (a bad definition) (Jamison, 2000).

### **2.3.2 Learners' intelligence and memory factors in mathematics classrooms**

Steele (2002) asserted that memory deficiencies cause learners to have difficulties in learning mathematical facts and remembering the correct sequence of steps for a particular mathematical skill such as memorizing the multiplication tables. Learners with persistent low achievement in mathematics displayed weak performance in word problems through all the grades (Reikeras, 2009). Learners experienced lack of success as a result of unsatisfactory teaching, thus leading to problems in learning mathematics.

### **2.3.3 Auditory, visual and motor factors in mathematics classrooms**

Other factors that are obstacles to mathematics learning mentioned are trouble with auditory processing, visual processing problems and motor processing problems. Steele (2002) stated that auditory learners

often have difficulty in understanding oral explanations of mathematical content and vocabulary. Visual processing problems are manifested when learners work problems in the wrong direction and reverse negative and positive numbers on a graph. Learners having motor processing difficulties often experience a hard time in writing numerals and that leads to errors in mathematics assignment and tests. Learners are also frustrated by problems that are complex and multistep. Cagle (2013) claimed that auditory, as a processing disorder, can lead to learners being misunderstood in the classrooms, teased by peers as well as receiving inappropriate intervention from the school authorities. Powell, Fuchs and Fuchs (2011) alluded to the idea that many learners have mathematical difficulties (MD) where they struggle to develop fluency with number combinations. This deficit may stem from difficulties in storing and retrieving number combinations from the long-term memory or keeping number combinations in the working memory.

#### **2.3.4 Linguistic diversity and home language in the classrooms**

It is clear that the word problems are interpreted for the learners to understand in the context of countries where English is taught as a second or foreign language and as a medium of instruction (Jan & Rodrigues, 2012). Jan and Rodrigues pointed out that learners' failure on word problems is due to a lack of linguistic knowledge. Moreover, Sepeng (2013) asserted that word problems in arithmetic require the integration of linguistic and arithmetic processing skills. Literature suggests that educators are monolingual and for that reason they struggle to respond adequately to the increased linguistic diversity that is found in the classrooms (Botes & Mji, 2010). They state that learners who are taught in a non-mother tongue language do not achieve academic excellence, not because they are not able, but because of the created artificial linguistic problem (p. 123). Primary pupils are taught by teachers who do not specialise in subjects during their training (Opolot-Okurut, n.d). This implies that even if the teacher is not competent in teaching mathematics he/she can be allocated to teach mathematics because he/she is a primary school teacher (Opolot-Okurut, n.d). Educators who are monolingual struggle in the increased linguistic diversity that is found in their classrooms when they have to effectively and adequately respond (Botes & Mji 2010). Research has shown that teaching techniques such as code-switching, translation and re-voice, might draw on and promote the use of home language of learners to enhance better understanding in mathematics classrooms (Sepeng, 2014).

#### **2.3.5 School level factors related to achievement**

School-related factors have a negative impact on learners' achievements where deficiencies of school components such as temperature, lighting, age and overcrowding exist (Saritas & Akdemir, 2009). Opolot-Okurut (n.d) suggested the following factors that could further affect learners' opportunities to learn mathematics: the characteristics of the pupils, the overcrowded classrooms, the nature of the curriculum and the syllabus, the government policies on education and the learning environment and assessment methods. A review by Sepeng (2013) revealed leadership, organization, management and decision-making within the school hierarchy and communication as important factors.

### **2.3.6 Social, emotional, behavioural and academic expectations and achievement**

According to Meece, Wigfield and Eccles's (1990) study, mathematics anxiety is related negatively to learners' performance on standardized tests of mathematics achievement in mathematics. Learners who do not perform well in mathematics often develop mathematics anxiety and phobia (Mundia, 2012). Mundia pointed out that in the context of the study conducted, mathematics anxiety and phobia referred to unreasonable worries and fear of mathematics and that this needs to be treated effectively. Steele (2002) refers to social, emotional and behavioural issues as factors that interfere with the achievement of success in mathematics as learners develop feelings of dependence because they believe they cannot work without teachers. On the other hand Josephine (1999) pointed out that an educator's bad attitude, poor teaching skills and lack of involvement with the learners when teaching result in poor performance of the learners in the subject. Educators' involvement in the learners' learning process is crucial as they are the primary contact that learners interact with when learning. Other factors mentioned by Josephine (2013) are lack of appreciation and fear of mathematics in general.

### **2.3.7 Learners' conceptions and perceptions of mathematics**

Aksu (2001) claimed that it is a general belief that mathematics is a difficult subject both to teach and learn (p.375). Kenneth (1992) reported that learners appeared to like solving word problems in mathematics the least. According to Kenneth learners were afraid to do and solve mathematics tasks associated with word problems, and were unable to apply arithmetic operations to real-life situations. It is stated in Steele (2002) that learners struggle even more than usual with word problems and new concepts and frequently "shut down" mentally when they see word problems because they associate these tasks with failure (p. 140). Moreover, the negative influence of the stereotype beliefs held by many people that mathematics is a difficult subject, was further alluded to by Mundia (2012).

### **2.3.8 Motivation and organisational issues in relation to achievement in mathematics classrooms**

The combination of reading, writing, reasoning, and mathematical skills required by word problems can make them extremely complex (Steele, 2002). According to Steele, learners find difficulty in organisational issues, more particularly in selecting and using appropriate strategies such as regrouping, which they then apply to all problems even when the strategy is not called for. Steele (2002) argued that learners' failure or lack of success leads to a loss of motivation which results in carelessness and inattention problems in solving word problems. Low-achieving learners often do not get the chance to work on problems that stimulate their interest as they lack the "readiness" skills required for solving the word problems in spite of their teachers offering them interesting word problems to solve (Conrad & Serlin, 2006).

Taylor (2005) stated that,

It all takes time to help students acquire a concept and definitions. Once understood, however, symbolic algorithms seem to take relatively little time to develop – and when asked to solve computational story

problems, students seem to have little difficulty in understanding the embedded relationships, numbers and operational procedures to be used (p.2).

### **2.3.9 Teacher level of proficiency and achievement in mathematics**

There are also instructional factors which necessitate that the learner should learn how to critically analyse mathematical problems and produce effective solutions to problems. These are instructional strategies and methods, teacher competency (weak academic backgrounds) in mathematics education, school context and facilities (Saritas & Akdemir, 2009). Saritas and Akdemir argued that every teacher requires having a firm understanding of the subject domain and the epistemology that guides the teaching of mathematics as well as an understanding of instructional activities that promote student achievement.

### **2.3.10 Family education values, expectations and support**

Saritas and Akdemir (2009) argued that parents' educational levels are a factor in the learners' academic achievement, for instance, learners whose parents had less than high school education obtained lower grades in mathematics than those whose parents had higher levels of education (p. 4). The parents encourage their children, serve as indicators of attitudes and values as well as create a home environment that can affect children's learning and achievement. Other authors pointed out the factors that affect the academic achievement of learners in mathematics in word problems, namely gender, family structure, parents' educational level, parent and student attitudes toward school and parent involvement (Fennema & Sherman, 1976, 1986; Epstein, 1991; Margolin, 2010; Campbell, Hombo & Mazzeo, 2000; Borman & Rachuba, 2001).

## **2.4 FACTORS THAT ARE ASSOCIATED WITH WORD PROBLEM SOLVING**

Solving word problems in mathematics classes by learners is a worldwide problem. Global and country-wide factors are associated with word problem solving. Globally, according to the report by the U.S. DoE, 2004, "In 2003, U. S. performance in mathematics literacy and problem solving was lower than the average performance for most Organisations for Economic Cooperation and Development (OECD) countries..." (p. iii). The U.S. learners scored lower than their peers in 25 of the OECD 38 countries in solving word problems.

According to the DoE (2011) report on the qualitative analysis of ANA 2011 results, the Grade 6 learners' competency who wrote ANA obtained only 9% in solving word problems. Solving word problems was the most difficult skill experienced by learners In the Department of Education (DoE, 2011).

The factors that are associated with word solving problems include English language as a medium of instruction, mathematical language use, text comprehension and understanding operations embedded in the text. According to Sepeng (2013) the factors that have an effect on learners' mathematics achievement when solving word problems include language clarity and word structure (p. 628).

#### **2.4.1 English language as a language of learning and teaching (LoLT)**

Mathematics teachers are facing a challenge of having a dual task, finding themselves teaching both Mathematics and English at the same time (Botes & Mji, 2010). These researchers pointed out that these learners are also faced with a challenge to learn to speak, read and write like mathematicians because mathematics has its own words, phrases, symbols and abbreviations that are unique. Ilany and Margolin (2010) stated that “in the solution of word problems, the student is faced with two languages mixed together: natural language and mathematical language” (p.138). This poses a challenge as most of the learners are taught in English language as a medium of instruction, yet it is most learners’ second language. On the same note Reikeras (2009) stated that the language in the word problems is referred to as consistent when the order in which information is given matches the order that problem solvers prefer and inconsistent when there is a mismatch and an inverse relationship placed in the correspondence text.

#### **2.4.2 Importance of Mathematical language used and achievement**

Other factors arising from literature are the teachers themselves who use mathematical language carelessly and in a confusing way, such as using the word “sum” to refer to a calculation other than addition (Haylock & Thangata, 2007). According to Haylock and Thangata, the misuse and degree of sloppiness in the mathematical use of words can be a barrier to learners’ understanding of mathematical concepts. The importance of language as a factor that affects learners in the development of the understanding and supporting problem solving in mathematics is emphasized by Pugalee (2001) and Sarmini (2009). As a result, learners are likely to make numerous errors when they encounter inconsistent language problems (Xin, 2007). On the other hand, Krick-Morales (2006) argued that “Many English Language Learners (ELLs) may have difficulty reading and understanding the written content in a word problem. If a learner is learning English as a second language, he might not yet know key terminology needed to solve the equation” (p. 3).

#### **2.4.3 Text comprehension and terminology of mathematics language**

The comprehension of the text in word problems is important as it is not only the means to convey information, but it is also used to interpret the event and phenomenon in a way that provokes the thinking of the learners (Jan & Rodrigues, 2012). Krick-Morales (2006) asserts that many of the English Language Learners (ELLs) experience difficulties in word problems in mathematics. Learners are required to read and comprehend the text of the problem, identify the question that needs to be answered and solve a numerical equation. This was confirmed by Jan and Rodrigues (2012) when they stated that learners are faced with difficulties in solving mathematical word problems most of the time because they do not comprehend the wording of the problem. They often misinterpret the problem as they rely on key words and come up with wrong answers. Learners actually mismatch between text comprehension, situation comprehension and problem solving procedures. Jan and Rodrigues (2012) on the other hand suggested that the learners do not comprehend word problems because the learners have a language

barrier. Jan and Rodrigues pointed out these learners rely on key words, otherwise they misinterpret the word problem and compute wrong answers.

#### **2.4.4 Understanding operations embedded in word problems**

Learners have trouble in listening to all the instructions and executing all the steps in a problem and completing all the work which requires mathematical skills difficult to master in solving word problems. Aksu (2001) argued that learners' performance declines significantly in all four operations when the operations are presented in the form of word problems with the greatest decline being in the multiplication operation. This is because learners lack the understanding of the different ways in which operations are embedded in word problems (Aksu, 2001). Learners need to acquire the skill to identify patterns and find "functions" that link several entities (DoE, 2011). According to Reikeras (2009) the calculation tasks are embedded in the text whose words and structure create problems (word problems).

#### **2.4.5 Mathematical symbols, concepts and vocabulary clarity and knowledge**

Solving word problems can be more challenging to culturally and linguistically diverse (CLD) learners due to the word problem containing vocabulary words and terms that are unfamiliar to them (Johnson, 2010). Johnson pointed out that CLD learners have to deal with recognizing the mathematical or cognitive demand as well as understanding the problem in context, which are two different aspects. Joy (2013) and Botes and Mji (2010) suggested that the barriers to learning mathematics include the learning of writing symbols, understanding mathematical concepts and inadequate knowledge of the basic vocabulary. According to Sepeng (2014), mathematical vocabulary includes technical terms, symbols, non-technical terms and words with multiple meanings. Botes and Mji (2010) pointed out that most learners' problems in mathematics originate from vocabulary knowledge that is not adequate. Ilany and Margolin (2010) suggested that mathematical terms and symbols must be defined unambiguously because every mathematical pattern has a deep structure that is determined by some operational rules (p.138). According to Botes and Mji (2010), other difficulties include; not understanding mathematical language; difficulty in transferring knowledge or connecting information and having spatial, perception and visual difficulties.

#### **2.4.6 Structure of the word problem**

It is stated in Reikeras (2009) that the structure of word problems strongly influences the performance in mathematics regardless of age and learners with persistent low achievement in mathematics display weak performance in solving word problems through all grades. According to Reikeras, in solving word problems, learners need to sufficiently develop verbal skills in order to construct an appropriate, initial representation of the problem. Voyer (2010) pointed out the factor of comprehension which could include representations based on the learners' real-world knowledge, in particular as a factor that influences learners' performance in solving word problems. It is also argued that highly articulate learners tend to dominate classroom discussions while low-academic achievers usually remain passive and even when

they participate, their contributions are comparatively weaker and their ideas are sometimes muddled (Sepeng & Webb, 2012). Also, Sarmini (2009) alludes to learners' difficulties and poor performance in solving mathematics word problems as emanating from linguistic nature rather than the intellectual or cognitive.

## 2.5 ERRORS MADE BY LEARNERS WHEN SOLVING WORD PROBLEMS

Learners often make errors when solving mathematical word problems in mathematics classrooms practices. According to Sepeng and Webb (2012), learners need to develop and know the skill of solving word problems so that they will know when and how to classroom mathematical knowledge as well as everyday life knowledge. This is confirmed by Russell (2013) who said that learning how to solve problems in mathematics is to know what to look for. This requires a learner to know the procedure, how to apply it, collect the appropriate information, identify and use strategy. He emphasized that solving problems in mathematics requires practice and more practice.

Steele (2002) asserted that learners make errors when computing word problems, more especially the learners who have visual processing difficulties. The following errors and practices occurred most often: confused numbers, such as 17 and 71; copied inaccurately; worked problems in the wrong direction; reversed negative and positive numbers on a graph; lined up work incorrectly for place value; used the number line in reverse and often lose their places when working. Learners who had difficulty in understanding complex ideas involving graphing inequalities switched the labels on x- and y-axes. Those learners who had motor processing difficulties, had a hard time writing numerals again which lead to errors on mathematics assignments and tests; made errors in finding common denominators and common multiples as well as having difficulties with memorising the multiplication tables (p.1).

Mundia (2012) on the other hand suggested error analysis from a research result carried out that was made by learners in their mathematics classrooms. The following errors came out in all four operations (addition, subtraction, multiplication and division): failure to regroup when adding and subtracting; zero difficulties, such as  $0-6=6$ ; difficulties with the relationship between units; tens, and hundreds is not clear; confusing multiplication with addition; confusing division with either addition or multiplication; using or mixing any two of the four process (+, -, x, ÷), for instance (p.353-355).

Miller (2013) argued that learners tend to think linearly, step-by-step, and try making the numbers and the text to match in the same order. Example:

*“Jane had 25 pens and she gave away 15. How many does she have now? Answer: 25-15.”*

Sepeng (2013) argued that we seem not to offer the learners enough exercises to enhance components of problem solving such as decoding and interpreting.

## **2.6 THEORETICAL FRAMEWORK**

The study is framed by the constructivist philosophy which underpins the view that learners are expected to discuss mathematics with their peers and their teachers in mathematics classrooms (Brenner, 1998). This theory views learning as an effective social interacting process that is undergone by learners and teachers. It takes the learner to collaborate with the adult at the “zone of proximal” development to accomplish a task. In their teaching and learning interaction, new knowledge is constructed to rethink ideas, to argue, evaluate, share, examine, as well as for the learners to understand the conceptual underpinnings of mathematics as they become better problem solvers (Hart, 1999 & Brenner, 1998). Learners are expected to gain a greater understanding of the conceptual underpinnings of mathematics and become problem-solvers through active discussion with their educator. This is a social construct theoretical perspective on teachers interacting with learners about a problem solving situation. From the constructive perspective that is grounded in the research of Piaget, Vygotsky, Gestalt psychologists, Bartlett, and Brunner as well as the philosophy of John Dewey, learners have to be active in constructing their own knowledge and social interactions enhanced as they are important to knowledge construction (Woolfolk, 2007).

This is also alluded to by Vygotsky (1978) as a social learning and cultural supports theorist that, the “zone of proximal development” is a term used to describe “the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (p.86). Dewey and Piaget concur stating that the learning of mathematics is a constructive process and much of current research on mathematics problem solving is consistent with these two. From a constructivist perspective, any curriculum aimed at promoting mathematical thinking must, by the very nature of the phenomenon, be problem based. In solving problems, mathematics knowledge should be constructed and relationships should be created as these are hallmarks of solving word problems (Thompson, 1985).

## **2.7 CONCLUSION**

This chapter sought to provide a review of literature drawn from research results of various authors locally and globally, on the factors that have an impact on learners in learning mathematics and solving word problems in primary schools. Various definitions were discussed under what constitutes word problem solving in a mathematics classroom. The factors that impede learners’ mathematics academic achievement were discussed, highlighting in particular issues associated with health and behaviour in learning mathematics, learners’ intelligence and memory factors, auditory, visual and motor factors, linguistic diversity and home language, school level factors, social, emotional, behavioural and academic expectations related issues, motivation and organisational issues, teacher level factors as well as family education values, expectations and support.

The factors that are associated with word problem solving were explored regarding English language as a language of learning and teaching (LoLT), the importance of mathematical language use and achievement, text comprehension and terminology of mathematics language, understanding operations embedded in word problems, mathematical symbols, concepts and vocabulary clarity and knowledge as well as the structure of the word problem. This chapter also highlighted the classroom practices and errors

made by learners when solving word problems. The theoretical framework that underpins the research study has been discussed.

Chapter 3 discusses the research methodology, research design and data collection techniques. It covers the mixed method research design, the current triangulation design, sampling strategies; purposive sampling and convenience sampling. The instrumentation, test, focus group interviews, face-to-face individual interviews and questionnaires were conducted in the exploration.

## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

#### **3.1 INTRODUCTION**

This chapter will focus on the discussion of the research approach, research design, population, sampling as well as data collection techniques. The instrumentation techniques covered a word problem task, focus group interviews, face-to-face individual interviews and questionnaires to be conducted will be explored. The data analysis methods, limitations of the study and issues of trustworthiness covering the validity and reliability of the study were also explored. The chapter concludes by providing a section pertaining to ethical considerations as far as the involvement of participants was concerned.

#### **3.2 RESEARCH APPROACH**

In this study a mixed-methods approach was used, utilising quantitative data to complement the qualitative information. According to Sepeng (2014), a mixed method approach maintains the strength of both approaches, having advantages that complement those of the other, making it a stronger research design. The data collected was triangulated with the aim of providing reliable data.

#### **3.3 RESEARCH DESIGN**

A research design refers to the general plan in terms of how the research is set up, what happens to the subjects, and which methods of data collection are used (Landsberg, Kruger & Swart, 2011). On the other hand, Babbie and Mouton (2001, p. 279) define a research design as “the road map or blueprint according to how one intends to conduct a research and achieve his research goals and objectives”.

The concurrent triangulation design was adopted for the purposes of this study. The researcher adopted concurrent triangulation because concurrent triangulation simultaneously gathers data quantitatively and qualitatively, and merges both methodologies in data analysis and interpretation of data for better understanding of a phenomenon of interest (Macmillan & Schumacher, 2010; Mundia, 2012). Moreover, Wahyuni (2012) argued that triangulation assists the researcher to collect more comprehensive relevant information as well as to cross-check their consistency in order to enhance the strength of the findings. In this study, the test consisting of WPTs was written first, marked and analysed before the other instruments were used. Thereafter, based on the findings of this instrument, the other three instruments were administered, informed by the results findings of the test. Thirty Grade 6 mathematics learners and two Grade 6 mathematics teachers were purposefully selected as a convenience sample for the study. The learners were the least performed ones in the grade and the teachers were the only two mathematics teachers in the grade of study. Moreover, they were easily accessed at the research site.

### **3.4 POPULATION AND SAMPLING STRATEGIES**

#### **3.4.1 Population**

MacMillan and Schumacher (2010) state that a population is a group of elements or case that conforms to specific criteria from which we intend to generalise the results of the study. The primary school where the research was carried out has a total of 1100 learners and 36 teachers, of which 300 learners were in grade 6.

#### **3.4.2 Sampling**

Sampling is a process of identifying relevant participants, subjects or people who are rich informants according to the researcher from which data can be collected. Macmillan and Schumacher (2010) maintain that sampling in mixed method research includes a selection of the participants mainly in both probability and nonprobability quantitative approaches to sampling and purposive qualitative approaches.

The researcher used the purposive sampling as one type of non-probability sampling in order to gain access to the individuals and groups being studied while in pursuit of understanding all the aspects of the research topic. The aim and purpose of using the purposeful sampling was to obtain detailed information from mathematics participants in order to maximise the range of specific information that can be obtained from the learners and teachers on the factors that affect academic achievement in Grade 6 mathematics classrooms in word problem solving (Macmillan & Schumacher 2010). On the other hand Sepeng and Sigola (2013) pointed out that purposive sampling enables the researcher to sample in a deliberate way with the purpose of selecting cases that are unique and informative in order to gain a deeper understanding of the nature and causes of a given phenomenon.

A convenient sample of 30 Grade 6 learners (10% of the learners) participated in the study. These learners were purposefully identified from the convenience sample from the first and second terms' results as they were readily available, to form part of the worst performing learners in mathematics. The teachers' Assessment Record Books were used to identify the learners. These learners were at the intermediate exit grade and they underwent the formal ANA. All 30 learners wrote a prepared task on solving word problems. All these learners used English, a foreign language, as a language of teaching and learning, as they were all isiZulu speakers. Twenty five per cent of the 30 (eight learners) were engaged in a focus group based on the mark attainment and the way in which they responded to the questions. Two Grade 6 mathematics teachers were part of the research. This was a convenient sample to work with that provided data on qualitative information covering pedagogical issues and instructional practices when they taught solving word problems related topics in the classrooms.

### **3.5 DATA COLLECTION STRATEGIES**

#### **3.5.1 Gathering data**

In gathering data in this study, four data collecting instruments were used: the task, consisting of six word problems, face-to-face and focus group interviews, questionnaire and a classroom observation schedule to

better understand the two teachers' instructional practices in their respective classrooms, were used. The data was collected concurrently as it was collected at more or less the same time.

**a) The word problem solving tasks (WPTs)**

The researcher administered a test consisting of word problem solving tasks (WPTs) which is quantitatively based. The WPT consisted of six questions given to the 30 participating learners. The test consisting of six WPTs were selected from a range of previous ANA tasks and all the selected tasks were in line with the standards of the Grade 6 curriculum with localised contexts. Annual National Assessment (ANA) is a systemic evaluation conducted annually by the Department of Education in Grades 3, 6 and 9 as a yardstick for the national performance. Sepeng and Sigola (2013) pointed out that the new South African Curriculum Statement (CAPS) places emphasis on teaching of problem solving to all grades. The selected WPTs formed part of the topics already covered in the current academic year as per their work schedule, which meant that WPTs were familiar questions to the participating learners. The word problems covered aspects on addition, subtraction, multiplication, subtraction with units, discounts, discounted amounts and subtraction, division, multiplication and subtraction. The aspects covered the four basic operations that learners in this grade should be able to solve. Learners were allowed to work individually so that their individual performance could be measured.

The results of the test assisted the researcher in understanding the learners' ways of solving problems and to measure their problem solving abilities. The learners' responses in the form of 30 scripts were marked and errors that were made by the learners were analysed in order to identify patterns of approaches or strategies employed during the problem solving process, as well as to determine how WPTs were solved. This provided quantitative information of how they performed and it informed the subsequent qualitative technique for the focus group that was conducted with a convenience sample of eight learners from the 30 learners that wrote the test. The researcher administered a test to 30 learners in order to measure their performances and understanding on what they have learned in solving word problems. This was also aimed at gathering information on how learners responded to word problems and found out the kind of mistakes they made. This informed and cross-validated the data findings from the interviews and questionnaires used. The intention of this instrument was to answer the research questions:

- I. How do learners solve word problems?
- II. What are the learners' problem solving abilities?

**b) The interviews (focus group and a face-to-face interview)**

The researcher conducted a focus group interview with eight learners selected from the 30 learners in the study. The focus group assisted in gathering the qualitative data at learner level. The focus group data enabled the current study to make sense of the factors that affected academic achievements in Grade 6 classrooms in word problem solving. An interview guide approach was used as the researcher decided and set the sequence and wording of interviews in advance. The two mathematics teachers were interviewed face-to-face. The focus group was used to create a space for learners to share their experiences of factors that affect their academic achievements and meanings that they make in solving word problems. In addition, the researcher explored the causes that prompted the learners to answer the way they did and their whole experience in solving word problems. This instrument served to cross-validate the result

findings from the WPT. The researcher started off the interviews by briefly explaining the aim of the study and emphasizing the confidentiality, anonymity and the voluntary nature of the study (Wahyuni, 2012). A tape recorder was used to record the interviews.

Macmillan and Schumacher (2010) are of the view that a focus group is designed to obtain maximum perceptions on a defined area of interest in a carefully planned discussion where the environment is non-threatening and permissive. In addition, another set of qualitative information was gathered from two mathematics teachers through a face-to-face semi-structured interview that covered issues to answer the research question on the factors that affect the learners' poor academic achievement in solving mathematical word problems. It also brought an understanding of the pedagogies and instructional practices in their classrooms when they taught topics related to word problem solving. The interviews provided qualitative data. The instrument was aimed at addressing the following question and objective:

- I. What are the factors that affect learners' poor academic achievement in Grade 6 mathematics word problems?
- II. Explore and understand the factors associated with poor academic achievements in Grade 6 mathematical word problems.

### **c) Questionnaire**

The 30 learners completed a questionnaire tailored for them. The data collected here were qualitative in order to triangulate with the quantitative data gathered from the WPT. The researcher used questionnaire because they enhance anonymity. They are economical with all the participants asked the same questions and that causes the researcher to ask specific information needed in the research, by which fairness is enhanced (Macmillan & Schumacher, 2010). The researcher distributed the questionnaires in person. The questionnaire sought to cross-validate the results from the findings gathered from the WPTs questions:

- I. How do learners solve word problems?
- II. What are the learners' problem solving abilities? and
- III. What are the factors that affect learners' poor academic achievement in Grade 6 mathematics word problems?

### **d) Classroom observations**

A classroom observation schedule for the two teachers was done twice a week over a period of four weeks. Qualitative data was gathered from this instrument. According to Sepeng (2013), such an instrument enabled the researcher to be both detached and involved in the topic of the study. Qualitative observations are when the researcher takes field notes on the activities and behaviour of the observed participant at the research site (Sepeng, 2014). The time schedule was randomly selected for each day, depending on the contact periods when the teachers had mathematics lessons. The checklist on the observation covered aspects on curriculum, methodology, content, teaching exercises, and organisational issues. This complemented the results on the performance of the learners on the written test as a measure

of quality in the educational system. The data collected through participant observation responded to the following question:

- I. What teaching strategies do teachers employ when teaching word problems?

### **3.5.2 Analysis method**

Data analysis was done in an integrated fashion, where data was analysed concurrently. Data analysis was done during and after data collection processes because the test was written first, marked and analysed, and the feedback on the performance informed the interviews and they corroborated with the questionnaires.

The study should be framed by the constructivist philosophy which underpins the view that learners are expected to discuss mathematics with their peers and their teachers in mathematics classrooms (Brenner, 1998). In this study, the teachers interacted with the learners but little was done in connection with the interaction of the learners with their peers. From a constructivist perspective, any curriculum aimed at promoting mathematical thinking must, by the very nature of the phenomenon, be problem-based. In solving, mathematics knowledge should be constructed and relationships should be created as these are hallmarks of solving word problems (Thompson, 1985). For the purpose of this study, the WPT administered to the learners were problem-based.

A review of what it means to solve mathematical word problems within South African classroom contexts has been pointed out by a number of authors to say, solving word problems are calculation tasks that are embedded in text and whose words and structure create problems that are called word problems. In the study at hand, the calculation tasks had to be derived from the text embedded in.

The factors that influence learners' academic performance such as issues associated with health and behaviour, learners' intelligence and memory, auditory factors, linguistic diversity and home language, school level factors, social and emotional, learners' conceptions and perceptions, motivation and organizational issues, teacher level factors as well as the family education values, expectations and support, as revealed by literature (Botes & Mji, 2010; Cagle, 2013; Hodge, et al. 2006; Loder-Symonds, 2012; Mundia, 2012; Saritas & Akdemir, 2009; Sepeng, 2013; Steele, 2002) have a negative impact on the academic performance of the learners.

As far as literature is concerned about the factors that are associated with word problem solving, the following should be considered: English language as a language of teaching and learning, the importance of the correct mathematical language use, text comprehension and terminology, understanding operations embedded in the text, mathematical symbols, concepts and vocabulary clarity and knowledge as well as the structure of the word problem (Aksu, 2001; Haylock & Thangata, 2007; ; Ilany & Margolin, 2010; Krick- Morales, 2006; Reikeras, 2009; Voyer, 2010).

The classrooms' practices and errors made by learners when solving word problems in this study confirms what was mentioned by Mundia (2012) ; Sepeng and Webb (2012), Steele (2002).

From the scripts of the 30 learners the researcher identified the problems and errors manifested. This provided data on how learners had answered the word problems, where they had difficulties, what kind of

difficulties and their overall performance, as a possible factor in affecting their academic achievements. The problem solving performance was evaluated based on the steps taken to obtain the solution for each part of the problem and the overall answer needed in order to qualify quantity requested.

Qualitative analysis is a relatively systematic process of coding, categorising, and interpreting data to provide explanations of a single phenomenon of interest (Macmillan & Schumacher, 2010). In this study the researcher used inductive analysis in order to synthesize and derive meaning from the data, starting with specific data on the attainment of marks and ending with categories and patterns.

The results from the test administered were presented in percentages to show the attainment level. The test was coded to realistic reaction (RR); no reaction (NR); and other reaction (OR) as adopted from the work of Sepeng and Webb (2012). It was also presented in a bar graph and interpreted against the pass mark in mathematics. The marks were first converted to percentages to find out how many learners attained marks less than 40 % and 40 % and above. A 40% mark qualifies a learner to progress to the next grade. Quantitatively, the descriptive statistics were used to present the data: the frequency distribution of scores, the histogram of scores, the frequency polygon (Macmillan & Schumacher, 2010). The questionnaires were analysed and interpreted qualitatively, in words and quantitatively through the use of tables and figures. The learners' focus group interview was analysed through the use of semantic analysis which provided the descriptive presentation of the qualitative data. The teachers' interviews were analysed through summarizing the data. The classroom observations were analysed through tables and use of words in summaries.

### **3.6 LIMITATIONS OF THE STUDY**

This research, like most research using mixed method research methodology, inherently warranted some cautions, as it did not provide all the answers to the research question. Firstly, the level of convergence of the quantitative and qualitative methods could not be completely justified as required and expected when using this kind of research methodology.

Secondly, there was a limitation involving the facilitator bias of the focus group methodology. As the facilitator, the researcher is an educator who might wish that the study would cover aspects not researched thus could temper with the results. Nevertheless, care was taken to optimize the reliability of the findings through the use of several sources.

Thirdly, the participants in this study came from one community. Thus the results could not be generalised in respect of other primary school populations.

### **3.7 ISSUES OF TRUSTWORTHINESS (VALIDITY AND RELIABILITY)**

As a methodology that employed both the quantitative and qualitative methodologies, the issues of trustworthiness (validity) combined both. Quantitatively, validity means the degree of trustworthiness of findings in the conclusions drawn. On the other hand qualitatively, validity refers to the degree to which

the interpretations have mutual meanings between the participants and the researcher (Macmillan & Schumacher, 2010). To enhance the above, the following data collection strategies were employed;

- i. Population external validity: the subjects that were used had variables such as age, sex and ability.
- ii. Multi-method strategies: the researcher applied triangulation in data collection and data analysis as qualitative design accommodates some numbers during its development.
- iii. Participant language: in order for the interviews to be phrased in the informant's language, not in abstract social science terms. The researcher was somewhat flexible to accommodate all the learners if the language happened to be a barrier.
- iv. Reflexivity: to see how I serve as a resource for selecting a qualitative approach framing the research problem.
- v. Member checking: the researcher checked informally with participants for accuracy during data collection.
- vi. Negative or discrepant data: the researcher actively searched for, recorded, analysed, and reported negative cases or discrepant data that were an exception to patterns or that modified the patterns found in data.
- vii. Low-inference descriptors: the researcher recorded precisely, almost literally, and detailed descriptions of people and situations (Macmillan & Schumacher, 2010).
- viii. The task to be written by learners which is part of the instrumentation was taken from previous papers that are aligned with the standards of the Annual National Assessments (ANA). This is a Grade 6 curriculum with localised contexts. The questions were administered to learners of the same grade over time.
- ix. All the participating learners answered the same questionnaire.

### **3.8 ETHICAL CONSIDERATIONS**

Bogdan and Biklen (2007) argue that official guidelines of ethics in this research are to ensure that informants enter research projects voluntarily, understanding the nature of the study and the obligations that are involved. Informants should not be exposed to risks that are greater than the gains they might derive.

Permission to conduct the research as an academic was requested from UNISA and in response, a Research Ethical Clearance Certificate was issued in that regard. Permission from the Department of Education and the school were requested to carry out the research at the participating primary school. The researcher requested permission from the principal to work with the two Grade six mathematics teachers in the study and also requested the teachers themselves. The researcher also obtained consent from the parents to work with their children in the study.

The researcher employed the following strategies to support the ethical approaches to fieldwork;

1. The researcher let the participants know that participation was voluntary and withdrawal without reprisal was accepted.
2. The researcher honoured the participants' privacy.

3. Unless otherwise agreed to, the informants' identities were protected so that the information collected did not embarrass or in any way harm them.
4. The informants were treated with respect and their cooperation in the research was sought.
5. In negotiating permission to do the study, it was made clear to those with whom negotiations were undertaken what the terms of the agreement were, and the researcher abided by that contract.
6. The researcher told the truth when writing up and reporting the findings (Bogdan & Biklen, 2007, p. 49-50; Saritas & Akdemir, 2009).

### **3.9 SUMMARY**

This chapter described the research method and approach taken in the study. The concurrent triangulation research design used was also discussed together with the purposive sampling and data gathering instruments, namely WPTs, focus group, face-to-face individual interviews, a questionnaire and teachers' observations. The chapter also explained the process used in collecting data as well as the ethical considerations that were taken into account. Chapter Four focuses on data presentation and in it all the collected data summaries are given, showing results of the findings and the drawings and figures to enhance representation of meanings and recommendations.

## **CHAPTER 4**

### **RESULTS AND DISCUSSIONS (DATA ANALYSIS AND INTERPRETATION)**

#### **4.1 INTRODUCTION**

This chapter discusses data processing and analysis of responses to the research question. The chapter seeks to provide explanations on potential factors that affect academic achievements in Grade 6 mathematics classrooms in a case of solving word problems. The analysis of the data was done by utilising tables, frequency counts and bar graphs. This chapter covers the following aspects; data analysis tools, the presentation of results, data analysis and the discussion of the results. The method used to analyse the data collected was summarising and thematic analysis. Themes that emerged from the data collected were identified through the use of thematic analysis. The following instrumentation tools were used: a test on solving word problems; questionnaires (one for the learners and one for the teachers); an observation schedule for the teachers and interviews (a focus group for learners and face-to-face interviews for the teachers).

#### **4.2 THE LEARNERS' TEST (WORD PROBLEM SOLVING TASKS)**

A formal written test consisting of six word problem tasks (WPTs) was administered to the learners. The test was aimed at assisting me to understand learners' ways of solving problems as well as their problem solving abilities. As noted earlier, the six WPT comprised carefully selected tasks obtained from a range of previous ANA assessments that were standardised within the prescripts of the Grade 6 South African Curriculum and Assessment Policy Statement (CAPS). All the WPTs conformed to local contexts of both the learners and the school. The six WPTs formed part of the topics already covered in the current academic year as per their work schedule. In other words, all the WPTs were familiar to the participating learners. Learners were allowed to work individually so that their individual performance could be measured. The learners' responses gathered from the 30 scripts were marked using a marking guideline that was validated by all teachers teaching Grade 6 mathematics in the participating school as well as those teaching in neighbouring schools. The errors made by the learners were analysed within a framework of theories and literature used in this study, with the primary aim of identifying patterns of approaches or strategies employed during the problem solving process, as well as to determine how WPTs were solved. The data gathered from the test provided quantitative information on learners' academic performances. Moreover, quantitative data obtained from the test was used to validate the qualitative information collected through focus group discussions with a convenience sample of eight learners. Both sets of data were then triangulated with data gathered from the questionnaires at the levels of both teachers and learners.

##### **4.2.1 Quantitative data (Structure of the WPT)**

The word problem task covered aspects on addition, subtraction, multiplication, subtraction with units, discounts, discounted amounts and subtraction, division, multiplication and subtraction.

The six questions from the written test were coded using a schema that was an elaboration of the classification scheme developed by Verschaffel, De Corte and Lasure (1994). The classification scheme comprised fourteen categories, which were reduced to three general categories. In this section, the frequency of learners per each question is presented in percentages, in tables as well as in pie charts. The coding in the categories are:

- *Realistic reaction (RR)*: All cases where a learner either gave the (most) correct numerical solution that also took into account the real-world aspects of the problem context, as well as cases where there was a clear indication that the learner tried to take into account those real-world aspects, without giving the mathematical and situational (most) accurate numerical answer.

- *No reaction (NR)*: All those cases where there is no indication that the learner was aware of the realistic modelling difficulty, for example, incorrect or inappropriate responses and computational errors. This category also provides a measure of the problem-solving performance of the learner.

- *Other reaction (OR)*: All cases where a learner did not provide a numerical response and did not give any written comment that indicated that the learner was aware of the realistic modelling difficulty that prevented him or her from answering the problem (Sepeng & Webb, 2012).

The researcher used the data depicted in Table 1 to discuss the learners' responses on the word problem solving on each task. Descriptive analyses were done using the frequencies (*f*) and percentages.

**Table 1:** Summary of the test analyses

Coding categories	RR		NR		OR	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
WPT 1	27	90	3	10	0	0
WPT 2	5	17	25	83	0	0
WPT 3	4	13	26	87	0	0
WPT 4	18	60	12	40	0	0
WPT 5	10	33	20	67	0	0
WPT 6	7	23	23	77	0	0
Mean		39		61		0

a) *Descriptive analysis of WPT 1*

WPT 1: There were originally 49 312 houses in Jefferson Township. During a housing boom, developers built 55 063 more. How many houses are now in Jefferson Township?

In WPT 1, learners were expected to add the number of houses in Jefferson township; 49 312 before the boom and 55 063 after the boom, in showing a real-life situation in a word problem statement. Question 1 of the task was based on addition, out of the thirty learners, only 90 % were categorised under the realistic

reaction (RR). They gave the most correct numerical solutions. Ten per cent of the learners fell into the no realistic (NR) category, where they gave incorrect or inappropriate responses, computation errors. The word “more” in mathematics terms usually means that the total number increases, so the addition (+) sign is used and as such the addition computation is applied. An analysis from the table shows that 90% (27) of the responses were mathematically correct, while only 10% (3) were incorrect. Analysis of the responses shows that the 90% learners were able to identify and relate the word “more” to addition in order to compute the task and obtain a correct or partially correct answer. Only 10% of the learners could not take the real-life world into consideration. They could not carry over from the units to the tens, couldn’t add properly or even used the wrong operation, a minus (-) instead of an addition operation. The analysis shows that all learners attempted to respond to the task whether correctly or incorrectly. The learners could not re-group the tens, carry the one ten from the units and add it to the tens to make it ten tens instead of the nine tens registered. This study concurs with Mundia (2012), who stated that the error analysis was made by learners from a research result carried out that they failed to regroup when adding and subtracting and had difficulty with the relationship between units, tens, and hundreds. The extract below is an example of such a case for WPT 1, due to the inability to use the incorrect operation.

**1.1 There were originally 49 312 houses in Jefferson Township. During a housing boom, developers built 55 063 more. How many houses are now in Jefferson Township? /2/**

The image shows two handwritten subtraction problems. The first problem is  $49,312 - 55,063$ . The student has written the result as  $10,351$ . The second problem is also  $49,312 - 55,063$ , with the result  $10,351$  written below. There are red markings, including a circled '0' and an arrow pointing to the result of the second problem.

*b) Descriptive analysis of WPT 2*

WPT 2: The Princeton Public Library purchased 9 015 books. Now the library has a total of 38 563 books. How many books did the library have before?

WPT 2 required the learners to get the difference of the number of books at the Princeton Public Library by subtracting the number of books that were purchased from the current number of books. Like in WPT 1, in WPT 2, the learners were supposed to take life into reality. Identify the phrase “how many...have before”. This was also a tribute to the language (English) proficiency. In order to make sense of the problem statement, learners had to use the mathematical language merged with the Language of Learning and Teaching (LoLT). Table 1 indicates that 17% (5) of the responses were mathematically correct or partially correct and 83% (25) were inaccurate. From the analysis of the learners’ responses for this task, most of the learners used addition instead of subtraction, most put the digits in the wrong place value and a few did not put any operation. The prominent error made in this category was the wrong placements of digits to be subtracted. Digits were placed in the wrong place value. This was coupled with the wrong operation used. The extract below shows an incorrect response that is a result of a combination of failure to align digits in their correct place value, numbers written wrongly and the use of the incorrect operation (+) instead of a subtraction (-), which is failure to take life into consideration:

1.2 The Princeton Public Library purchased 9 015 books. Now the library has a total of 38 563 books. How many books did the library have before? 65353 12/

$$\begin{array}{r}
 9015 \\
 + 38563 \\
 \hline
 65353
 \end{array}$$

~~65353~~ 0/

c) Descriptive analysis of WPT 3

WPT 3: A train travels at 100 km per hour. How far will it travel in  $9\frac{1}{2}$  hours?

In Table 1, 13% (4) of the respondents gave accurate answers and 87% (26) gave inaccurate answers. Learners had to multiply the speed by the number of hours in order to get the distance. They were also expected to give the units of distance which was kilometres (km). Learners worked out the answers without understanding and thus gave a logically incorrect answer. It seemed that the learners were not sure of the computation technique they needed to use. The language barrier was prominent in this task. It also seems that learners use whatever operation comes to their minds first or they do guesswork. Most of the learners used a plus sign instead of the multiplication (x) sign in order to get a product. In some responses there were no operations given. In other responses it was either wrong units or no units at all given. The following is an ideal example of a response with no computation, but only an answer with wrong units:

1.3 A train travels at 100km per hour. How far will it travel in  $9\frac{1}{2}$  hours? 13/

~~100~~ 3 hours 1

0/

d) Descriptive analysis of WPT 4

WPT 4: Pedro travels to Pretoria which is 92, 3 km from his home. After driving for 56,7 km, he stopped for fuel. How far was he then from Pretoria?

The results of Table 1 shows that 60% (18) of the learners gave correct or partially correct answers and 40% (12) gave wrong answers. WPT 4 required the learners to subtract the two figures and give units of km as part of the answer. This task appeared similar to WPT 2 as it used the same operation. Learners had to understand the mathematical language and the language of instruction in order for their schema to use the correct operation. What I noted from the learners' responses was that, most of them again added instead of subtracting. Some of the learners used wrong figures altogether to compute their tasks. The following response is evidence of the latter:

1.4 Pedro travels to Pretoria which is 92, 3 km from his home. After driving for 56,7km, he stopped for fuel. How far was he then from Pretoria? /3/

$$\begin{array}{r}
 92 \\
 30 \\
 56,7 \\
 \hline
 780 \\
 \hline
 58
 \end{array}$$

e) Descriptive analysis of WPT 5

WPT 5: All the articles in a store are marked down by 25%. What will Thilani pay for a shirt that was marked R200 before the discount?

Data from the results in this question indicate that about two-thirds of the learners obtained computationally wrong responses and situationally inappropriate solutions. Out of the 33% (10) learners who took into account the real-life aspects, about 80% got incomplete and partially correct answers. Some had no discount amount computed and others had no marked down solutions. This task was a two-step task. It needed the learners to understand and identify the operations embedded in the text. Learners had to first find a discount, by getting 25% of R200, thereafter subtract the answer obtained from the initial amount of R200 in order to get the discounted figure. Learners failed to show awareness of the modelling aspect of the task. Such a task shows the measure of the problem-solving performance of the learners, when they eventually give inappropriate responses. The extract below shows a learner’s response as a result of lack of inability to model a word problem:

1.5 All the articles in a store are marked down by 25%. What will Thilani pay for a shirt that was marked R200 before the discount? /5/

$$\begin{array}{r}
 25\% \\
 200 \\
 \hline
 105
 \end{array}$$

f) Descriptive analysis of WPT 6

WPT 6: Mr Msebenzi buys 480 sweets for R30,00. He repacks the sweets into packets of 24 each. He sells the packets for R2, 50 each. How much profit will he make if he sells all the sweets?

WPT 6 seemed to be one of the challenging tasks in the grade. It needed the learners to show like in WPT 5 the indication of the realistic modelling aspect it and also needed the learners to use their schema to engage the correct operation in this task. It is a multi-step task that needed the learners to divide the sweets by the number of packets, take the quotient and multiply it by R2.50 to get the total amount of the

sales, lastly, subtract the two amounts in order to obtain the profit made. In this task, 23% (7) learners obtained partially correct solutions. Not a single learner got the whole question correct. All together 77% could not understand the task, by the show of the incorrect solutions. The following is an extract showing the response of a learner who showed no indication of the realistic modelling of the word problem:

**1.6 Mr Msebenzi buys 480 sweets for R30, 00. He repacks the sweets into packets of 24 each. He sells the packets for R2, 50 each. How much profit will he make if he sells all the sweets?**

**15/**

$$\begin{array}{r}
 480 \\
 30,00 \\
 24 \\
 \hline
 2,50 \\
 \hline
 37,54
 \end{array}$$

0/

#### 4.2.2 Discussion on the WPTs results

In discussing the word problem tasks, the researcher elaborated on; what constitutes word problem solving in a mathematics classroom; factors that affect learners' mathematics academic achievement; factors that are associated with word problem solving and errors made by learners when solving word problems.

##### 4.2.2.1 What constitutes word problem solving in a mathematics classroom?

The findings of the data collected in this study reported here, illustrate that learners experienced difficulties in solving the word problems. It seemed that they encountered difficulties in understanding and interpreting the tasks. This might have been caused by;

- i) Solving word problems with calculation tasks that are embedded in text and whose words and structure create problems that are called word problems. In the study at hand, the calculation tasks had to be derived from the embedded text (Reikeras, 2009).
- ii) Failure to make sense of the mathematical word problems that deal with mathematical relationships between objective sizes and those that deal with real life situations (Ilany & Margolin, 2010).
- iii) Failure to apply the correct operation needed for the task, as Kenneth (1991) pointed out that word problems provide a context through which learners practice the algorithms and apply the formulas which they are learning.

##### 4.2.2.2 Factors that affect learners' mathematics academic achievement

The other findings that emerged from these results were issues on factors that affect the learners' mathematics academic achievement. These factors could have emerged from issues such as the health and

behaviour, learners' intelligence and memory, auditory factors, linguistic diversity and home language, school level factors, social and emotional, learners' conceptions and perceptions, motivation and organizational issues, teacher level factors as well as the family education values, expectations and support (Botes & Mji, 2010; Cagle, 2013; Hodge, et al. 2006; Loder-Symonds, 2012; Mundia, 2012; Saritas & Akdemir, 2009; Sepeng, 2013; Steele, 2002)). They had a negative impact on the academic performance of the learners. The researchers reported that learners seemed to have difficulty in solving word problems in arithmetic that require the integration of linguistic and arithmetic processing skills and learners' failure on word problems is due to a lack of linguistic knowledge. It was evident also from this study what Botes and Mji (2010) pointed out, namely that learners who are taught in a non-mother tongue language do not achieve academic excellence, not because they are not able but because of the created artificial linguistic problem.

Authors such as Steele (2002) argued that learners struggle even more than usual with word problems and new concepts and frequently "shut down" mentally when they see word problems because they associate these tasks with failure. From the findings of this study learners seemed to "shut down". The findings illustrated that the learners found the combination of reading, writing, reasoning, and mathematical skills required by word problems extremely complex (Steele, 2002) because they did not show any reasoning skill when applying their operations. Faced with this problem, it is crucial that mathematics knowledge should be constructed and relationships should be created as these are hallmarks of solving word problems (Thompson, 1985) and the teachers should constructively involve the learners in the process of teaching and learning (Josephine, 2013).

#### **4.2.2.3 Factors that are associated with word problem solving**

Factors such as English language as a language of teaching and learning, the importance of the correct mathematical language use, text comprehension and terminology, understanding operations embedded in the text, mathematical symbols, concepts and vocabulary clarity and knowledge as well as the structure of the word problem (Reikeras, 2009; Haylock & Thangata, 2007; Krick- Morales, 2006; Aksu, 2001; Ilany & Margolin, 2010; Voyer, 2010) might have caused the learners not to produce correct solutions in their word problem solving tasks in this study. The findings of this study indicated that learners were faced with the difficulty of two languages mixed together: natural language and mathematical language. They could not make sense of the words and phrases used. Learners are said to make numerous errors if they encounter language problems (Sarmini, 2009). The comprehension of the text in word problems is necessary as that is not only the means to convey information but it is also used to interpret the event and phenomenon in a way that provokes the thinking of the learners (Jan & Rodrigues, 2012). The findings that emerged from this study indicated that learners could not comprehend the text, thus they could not interpret what was required of them to do because they have a language barrier.

The data collected in this study demonstrated what Aksu (2001) claimed, namely that learners' performance declines significantly in all four operations when the operations are presented in the form of word problems. The greatest decline was in the multiplication operation. The findings of this study illustrated 13% respondents who got multiplication task (WPT 3) solutions correct, which was the lowest in all six tasks. WPT 5 with 33 % and WPT 6 with 23 % correct responses also had multiplication

computation that the learners needed to do. Learners had difficulties in identifying and interpreting the terms and words in the word problem as Sepeng (2014) argued that mathematical vocabulary includes technical terms, symbols, non-technical terms and words with multiple meanings. For WPT 2, learners could not identify the phrase “how many...have before”, that it needed a subtraction operation. Learners demonstrated lack of representations based on their real-world knowledge, in particular as a factor that influences learners’ performance in solving word problems (Voyer, 2010).

#### 4.2.2.4 Errors made by learners when solving word problems

On issues mentioned by Sepeng and Webb (2012), Steele (2002 and Mundia (2012) on classroom practices and errors made by learners when solving word problems, the findings of this study have confirmed the numerous errors computed by learners. The findings of this study illustrated that learners did not take into account the real-world aspects of the problem context. They obtained computationally incorrect and situationally inappropriate answers. Their solutions showed that there was no indication of the use of logical reasoning. In most if not all of the six tasks, learners used an addition sign without thinking if that was the correct operation needed. Scholars such as Pape and Wang (2003) alluded to the idea that problem solving begins when the solver reads the problem text for the solution process that leads to success as the schemas for problems are activated. They lack a schema to shape their critical thinking. Learners mixed or confused any of the four processes or operations such as confusing a subtraction (-) and applied an addition (+) (Mundia, 2012). The learners illustrated to have memory deficiencies that caused difficulties in learning mathematical facts and remembering the correct sequence of steps (Steele, 2002). For WPT 5, learners could not remember to work out 25% of R200 first, and then subtract the answer from the initial buying price in order to get the amount of the discounted items.

From the constructive perspective that is grounded in the research of Piaget, Vygotsky, Gestalt psychologists, Bartlett, and Brunner as well as the philosophy of John Dewey, learners have to be active in constructing their own knowledge and social interactions enhanced as they are important to knowledge construction (Woolfolk, 2007).

**Table 2:** Learner performance levels

<b>Level /key</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>1 ( 0% - 29% )</b>	<b>28</b>	<b>93.3</b>
<b>2 (30% - 39%)</b>	<b>01</b>	<b>3.3</b>
<b>3 (40% - 49%)</b>	<b>01</b>	<b>3.3</b>
<b>Total</b>	<b>30</b>	<b>100</b>

The learners' performance results are reflected in Table 2 above were reported on out of totals of 20 marks, with percentages and performance keys or levels (1-7) also given. The results showed that the learners' performances ranged from Key 1 (00% - 29%), to Key 2 (30% - 39%), while the highest attained key was level 3 (40% - 49%). Twenty-eight (93.3 %) learners out of the thirty attained Key 1 (00%-29%). One learner (3.3%) attained Key 2 (30% - 39%) whilst the last one (3.3%) attained Key 3 (40%-49%). The progression requirement, as per the Department of Education for the Foundation and Intermediate Phases (DoE, 2012) stipulates that in a primary school, a learner must attain a minimum mark of level three (40 %) in mathematics in order for him or her to progress to the next class. This implies that any failure to secure key three in mathematics, of which word problem solving is part, will prevent the learner from progressing to the next level.

For a particular mathematical skill such as memorising the multiplication tables, remembering the correct sequence becomes difficult (Steele, 2000). According to Steele, obstacles to mathematics learning mentioned are challenging with auditory processing, visual processing problems and motor processing problems. Learners with auditory problems often have difficulty in understanding oral explanations of mathematical content and vocabulary. Visual processing problems are manifested when learners work problems in the wrong direction and reverse negative and positive numbers on a graph. Learners with motor processing difficulties often experience a hard time in writing numerals and that leads to errors in mathematics assignments and tests. Learners are also frustrated by problems that are complex and multistep. Powell, Fuchs and Fuchs (2011) allude to the idea that many learners have mathematical difficulties (MD) where they struggle to develop fluency with number combinations. This deficit may stem from difficulties in storing and retrieving number combinations from the long-term memory or keeping number combinations in the working memory.

#### **4.3 QUESTIONNAIRE: (LEARNERS)**

The data collected from the 30 learners through the questionnaire was qualitative and the three-item Likert scale was used. Frequency tables, percentages and bar graphs were used to present the collected data in this section. A total of 30 learner questionnaires were sent out to be completed. All thirty questionnaires were brought back, giving a 100% response.

##### **4.3.1 Qualitative descriptions**

Following in this section are frequency tables and bar graphs presenting the biological information on learners and their responses to the questionnaire statements:

**Table 3: Learners' Biographical Information**

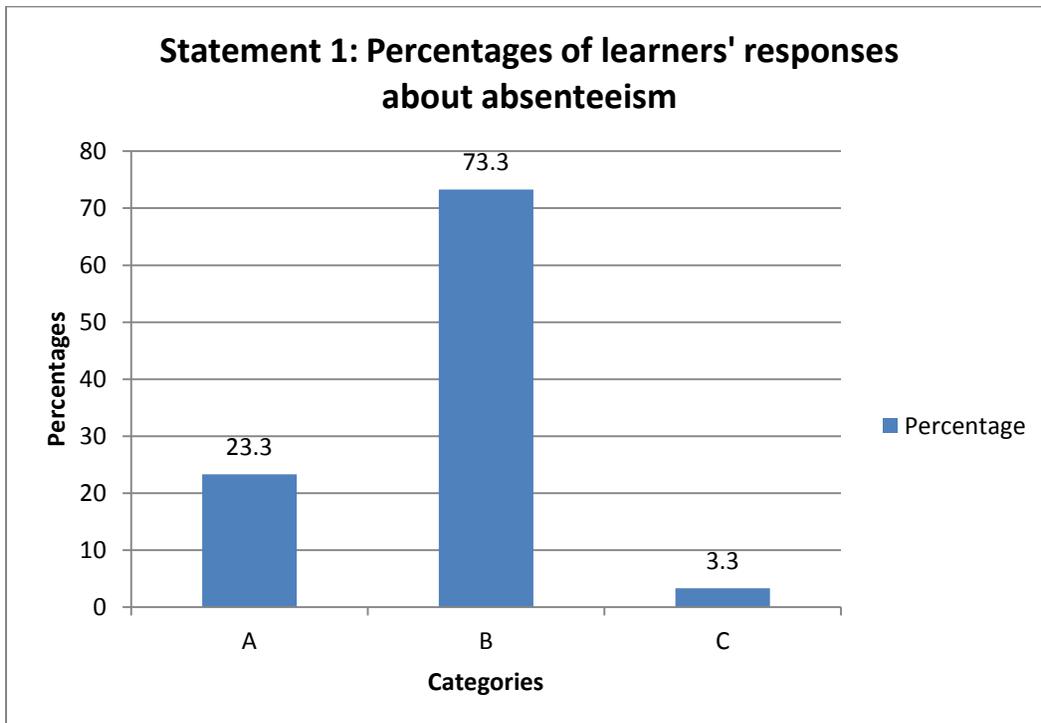
<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
Gender: Males	<b>15</b>	<b>50</b>
Females	<b>15</b>	<b>50</b>
<b>Total</b>	<b>30</b>	<b>100</b>
Age: 10-12 years old	<b>18</b>	<b>60</b>
13-14 years old	<b>12</b>	<b>40</b>
15 years old and above	<b>None</b>	
<b>Totals</b>	<b>30</b>	<b>100</b>
Either a grade was repeated or not		
Yes	<b>07</b>	<b>23</b>
No	<b>23</b>	<b>77</b>
<b>Total</b>	<b>30</b>	<b>100</b>

Out of the 30 learners, 15 were males and 15 were females. A proportion of 60% of the learners are between the ages of 10 and 12 whilst 40% are between 13 and 14. A total of 7 learners have once repeated a grade whilst 23 learners have never repeated a grade.

The findings of this study reflect what is claimed by Reikeras (2009) that the structure of word problems strongly influences the performance in mathematics regardless of age and learners with persistent low achievement in mathematics display weak performance in solving word problems through all grades. The learners were at an acceptable average age range for Grade 6 learners whether they repeated a grade or not.

**Table 4:** Learners’ Responses to statements 1 to 10

<b>Category</b>	<b>Not at all (1)</b>	<b>Sometimes (2)</b>	<b>Always (3)</b>	<b>Total no of Learners percentage</b>
<b>Statement (Stat) 1</b> <b>Frequency (f)</b> Percentage (%)	07 23.3	22 73.3	01 3.3	<b>30</b> <b>100</b>
<b>Stat 2</b> <b>(f)</b> Percentage (%)	02 6.6	15 50	13 43.3	<b>30</b> <b>100</b>
<b>Stat 3</b> <b>(f)</b> Percentage (%)	01 3.3	11 36.6	18 60	<b>30</b> <b>100</b>
<b>Stat 4</b> <b>(f)</b> Percentage (%)	01 3.3	15 50	14 46.6	<b>30</b> <b>100</b>
<b>Stat 5</b> <b>(f)</b> Percentage (%)	0 0	11 36.6	19 63.3	<b>30</b> <b>100</b>
<b>Stat 6</b> <b>(f)</b> Percentage (%)	02 6.6	22 73.3	06 20	<b>30</b> <b>100</b>
<b>Stat 7</b> <b>(f)</b> Percentage (%)	03 10	21 70	06 20	<b>30</b> <b>100</b>
<b>Stat 8</b> <b>(f)</b> Percentage (%)	01 3.3	13 43.3	16 53.3	<b>30</b> <b>100</b>
<b>Stat 9</b> <b>(f)</b> Percentage (%)	03 10	19 63.3	08 26.6	<b>30</b> <b>100</b>
<b>Stat 10</b> <b>(f)</b> Percentage (%)	01 3.3	16 53.3	13 43.3	<b>30</b> <b>100</b>



**Figure 1:** Statement 1: Learners' responses about absenteeism

In all bar charts, categories represent;

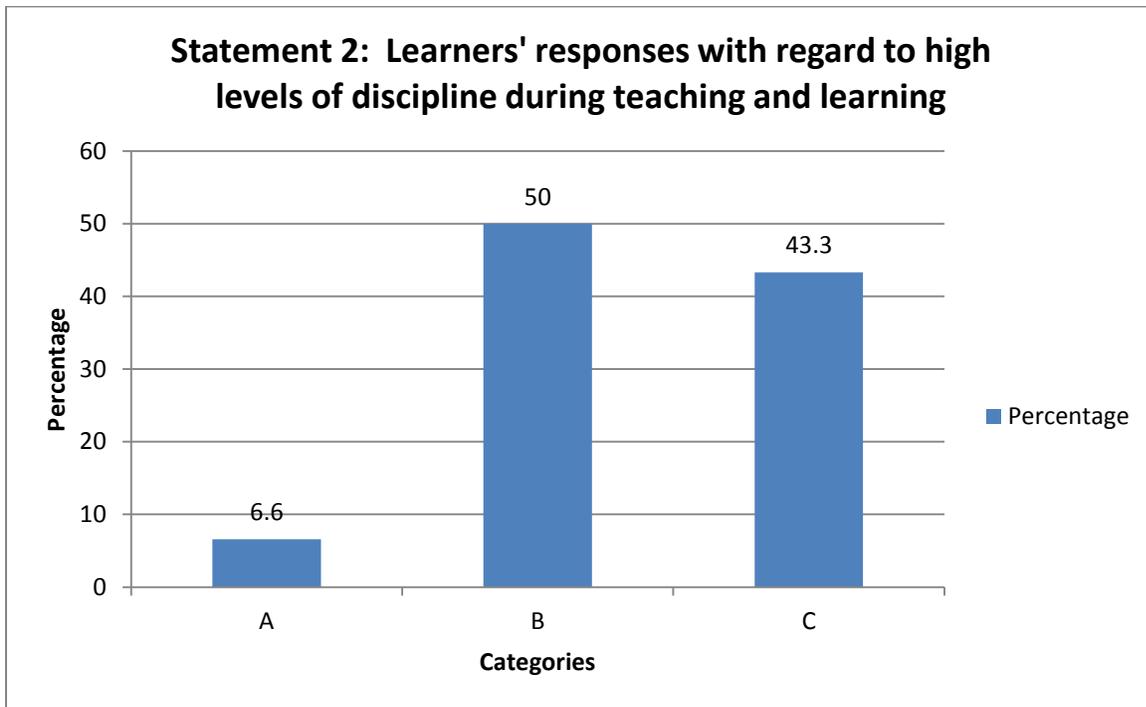
**A = Not at all**

**B= Sometimes**

**C= Always**

For this statement, out of the 30 learners, a total of 23.3% had not been absent from mathematics classes at all. On the other hand, 73.3% of the learners had been sometimes absent whilst 3.3% had always been absent from mathematics classes. The low percentage of learners who had not been absent at all from mathematics classes shows that absenteeism could be one of the factors affecting their academic achievement.

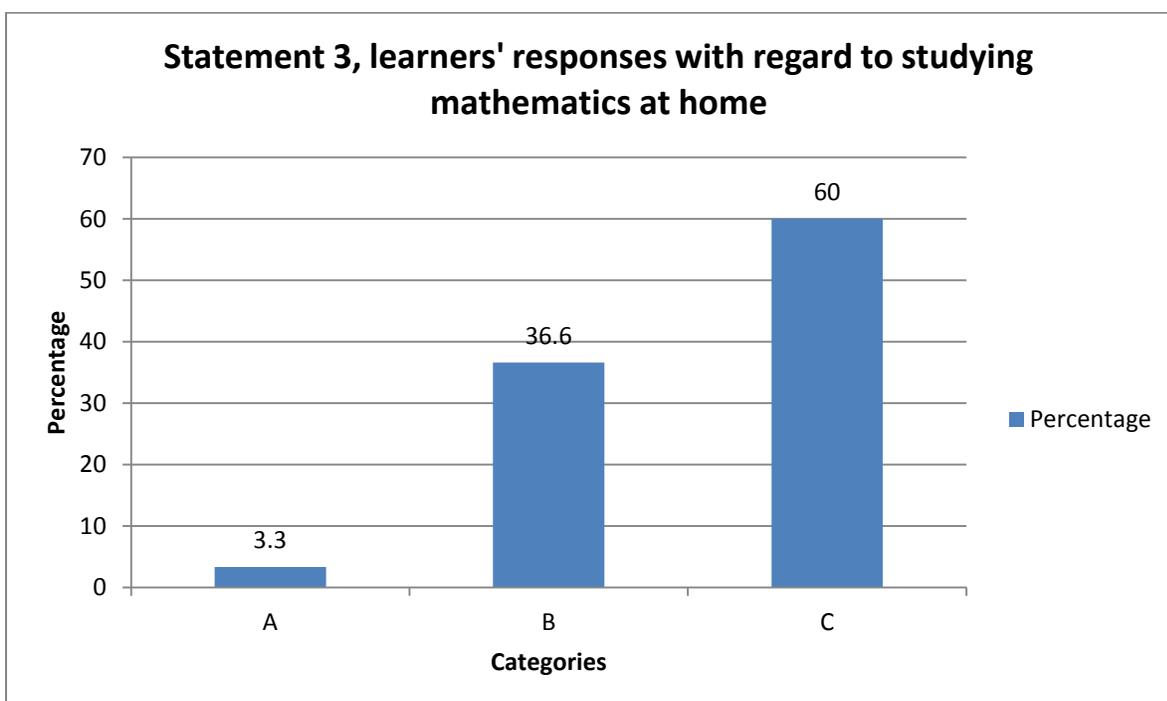
From the results of the findings, absenteeism from class could have also contributed to the learners not performing in an acceptable way as, Russell (2013) emphasized that solving problems in mathematics requires practice and more practice. So if they are constantly absent, then they lose out on the daily practising. Learning how to solve problems in mathematics is to know what to look for. This requires a learner to know the procedure, how to apply it, collect the appropriate information, identify and use the strategy.



**Figure 2:** Statement 2: Learners’ responses to high levels of discipline that they display during teaching and learning

Statement 2 is on learners’ responses with regard to the levels of discipline during teaching and learning. Only 6.6% of the respondents admitted that they did not display high levels of discipline at all during teaching and learning. All together 50% said that sometimes they did and sometimes they did not instill any levels of discipline. The last 43.3% of the respondents said that they always display high levels of discipline during teaching and learning.

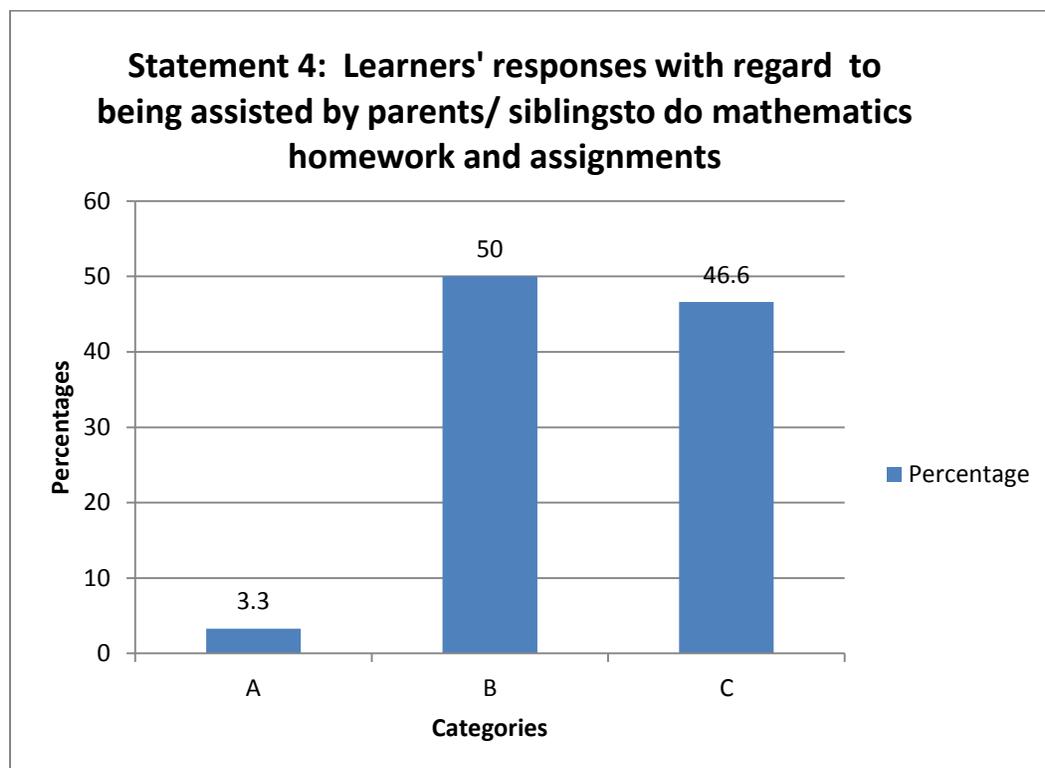
From the results obtained, the level of discipline was average and as such it does not come as a treat to the learners’ academic achievements. Hodge, Riccomini, Buford and Herbst (2006) are of the idea that externalising behaviours such as aggression and delinquency negatively affect learners especially those with emotional and behavioural disorders (EBD) in several content areas including mathematics.



**Figure 3:** Statement 3: Learners' responses with regard to studying mathematics at home

With regard to studying mathematics at home, 3.3% of the respondents said that they do not study at all. All together 36.6% said they study sometimes and 60% mentioned that they always study mathematics at home.

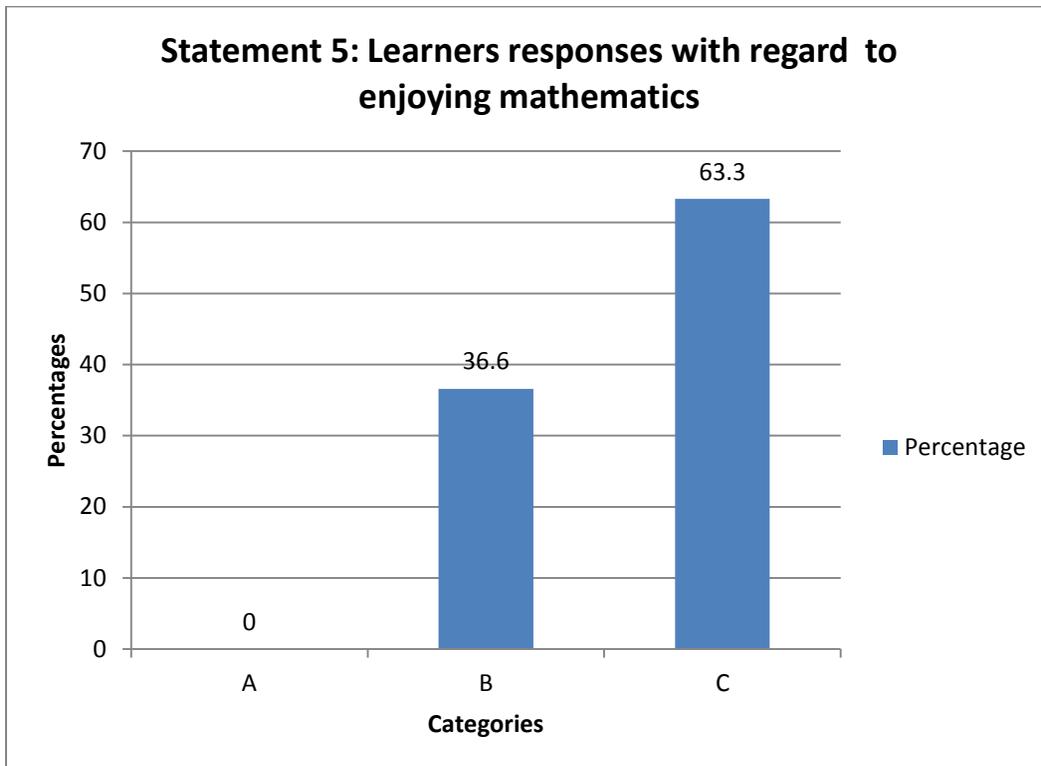
In so far as most learners said they study at home, there could be factors such as the ones mentioned by Sepeng (2013, p. 628), who suggested that the factors that have an effect on learners' mathematics achievement when solving word problems include personal characteristics, motivation, race, gender, student intelligence, home language, self-esteem and self-efficacy, academic expectations and effort, language clarity, word structure and patterns as well as family education values, expectations and support.



**Figure 4:** Statement 4: Learners' responses with regard to being assisted by parents / siblings to do mathematics homework and assignments

With regard to learners being assisted by parents or siblings to do mathematics homework, assignments, etcetera, 3.3 % of the learners/respondents were not at all helped by their parents or siblings. Half of the respondents were sometimes helped whilst 46.6 % claimed that they were always helped at home by their parents or siblings.

The findings revealed that about 50% of the learners were helped at home but still could not perform well. One could be sceptical that there are other underlying factors that may affect the academic achievement of learners in mathematics in word problems such as family structure, parents' educational level, parent and student attitudes toward school and parent involvement (Fennema & Sherman, 1976, 1986; Epstein, 1991; Fluty, 1997 in Ilany and Margolin, 2010: 2; Campbell et al., 2000; Borman & Rachuba, 2001).

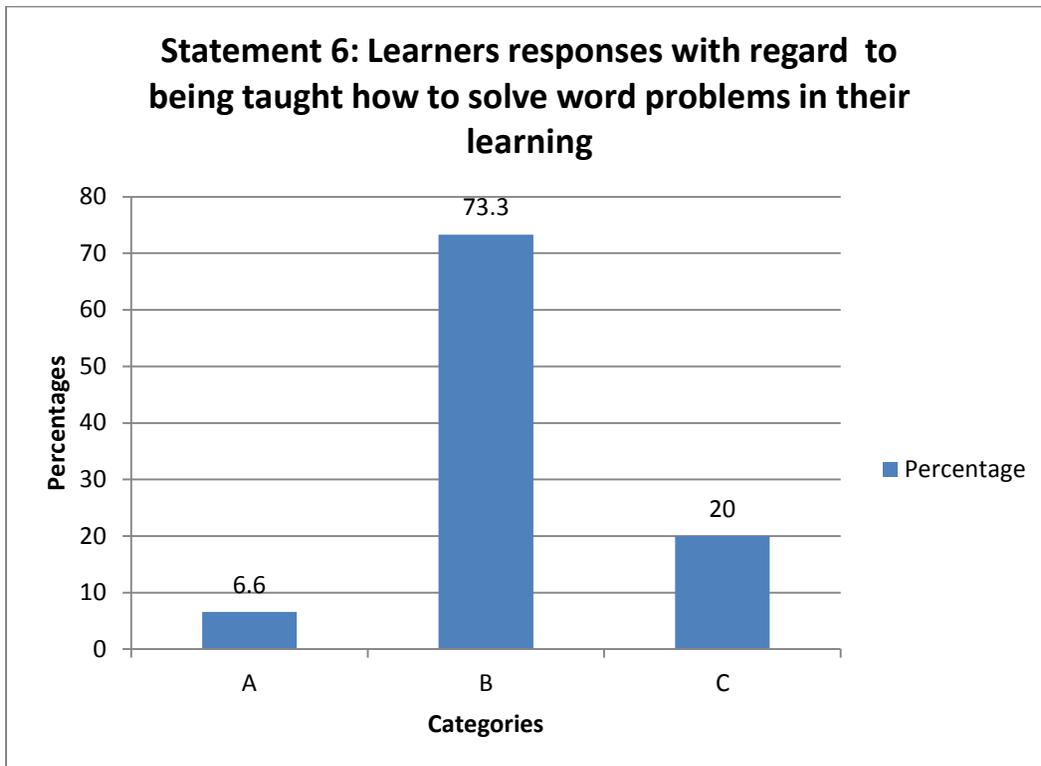


**Figure 5:** Statement 5: Learners responses with regard to enjoying learning mathematics at school

With regard to enjoying mathematics at school, none of the respondents registered not to like mathematics. Almost a third (36.6%) of the total percentage of learners mentioned that they sometimes enjoy mathematics 63.3% admitted to always enjoying mathematics at school.

As much as over 60% claim that they enjoy mathematics, but their result findings from the test (WPT) they wrote is in conflict with this finding. From the WPT the overall result performance was, twenty eight (93.3%) learners out of the thirty attained key 1 (00%- 29%) One learner (3.3%) attained key 2 (30% - 39%) whilst the last one (3.3%) attained key 3 (40%-49%). The progression requirement, as per the Department of Education (2012) stipulates that in a primary school, a learner must attain a minimum mark of Key 3 (40%) in mathematics in order for him or her to progress to the next class. This implies that any failure to secure key three in mathematics, of which word problem solving is a part, the learner will not be able to progress to the next level.

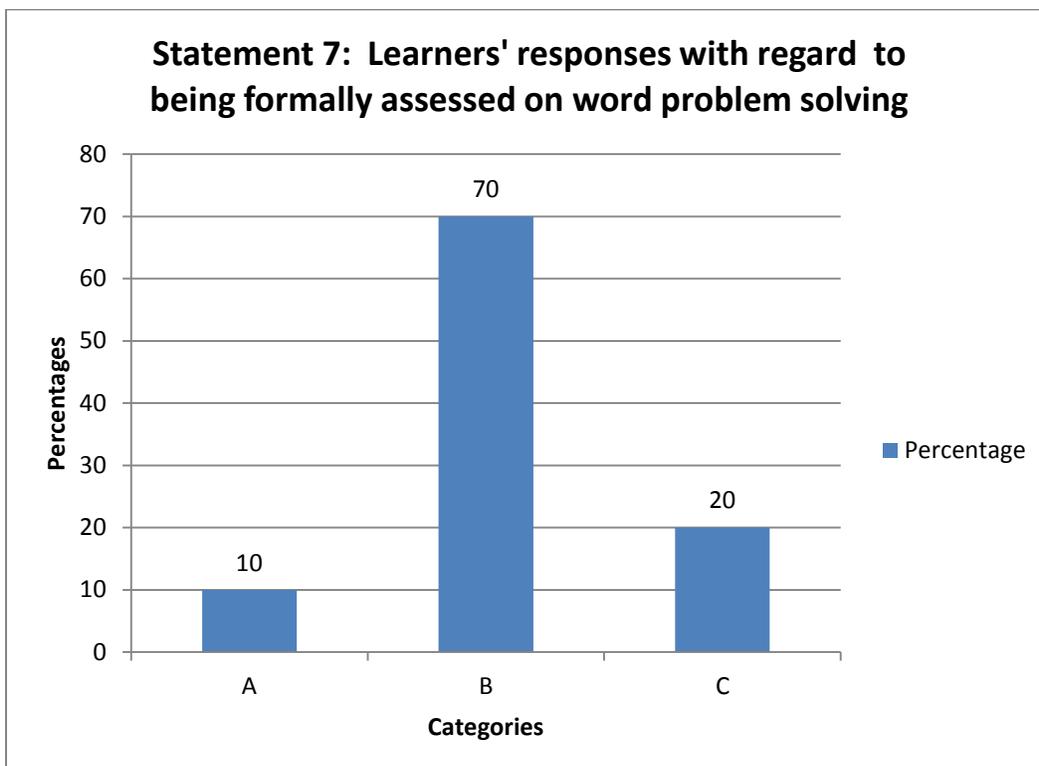
It is stated in literature that low-achieving learners often do not get the chance to work on problems that stimulate their interest as they lack the “readiness” skills required for solving the word problems in spite of their teachers offering them interesting word problems to solve (Conrad & Serlin, 2006).



**Figure 6:** Statement 6: Learners’ responses with regard to being taught how to solve word problems in their learning

Only 6.6 % of the learners claimed that they were never taught how to solve word problems. The majority of learners at 73.3 % claimed that they were sometimes taught how to solve word problems in their learning and the 20 % admitted to have been taught how to solve word problems.

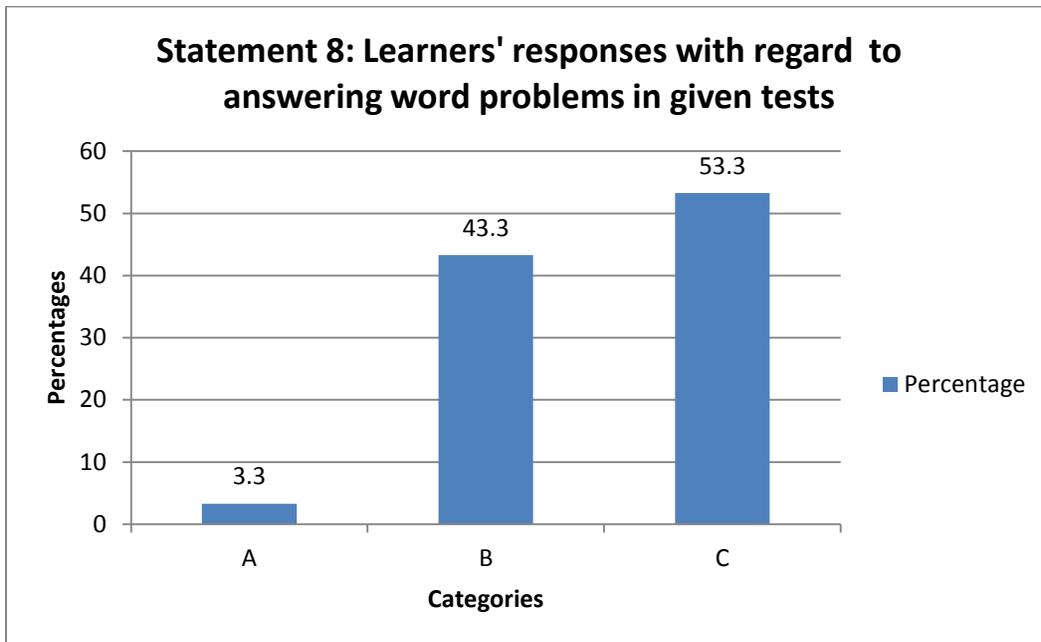
Conrad and Serlin (2006) are further supported by Joy (2013) and Botes and Mji (2010) who suggest that the barriers to learning mathematics include learning to write symbols, understanding mathematical concepts and inadequate knowledge of the basic vocabulary. Other difficulties include; not understanding mathematical language; difficulty in transferring knowledge or connecting information and having spatial, perception and visual difficulties. The majority of the above learners are best explained by the above authors.



**Figure7:** Statement 7: Learners’ responses with regard to being formally assessed on word problem solving

With regard to statement 7, 10% of the respondents stated that they were never formally assessed on solving word problems in the tests or any assessment that they wrote. Seventy per cent of the learners indicated that sometimes they found word problems in the assessments they wrote and only 20% admitted that they always found word problems in their assessments.

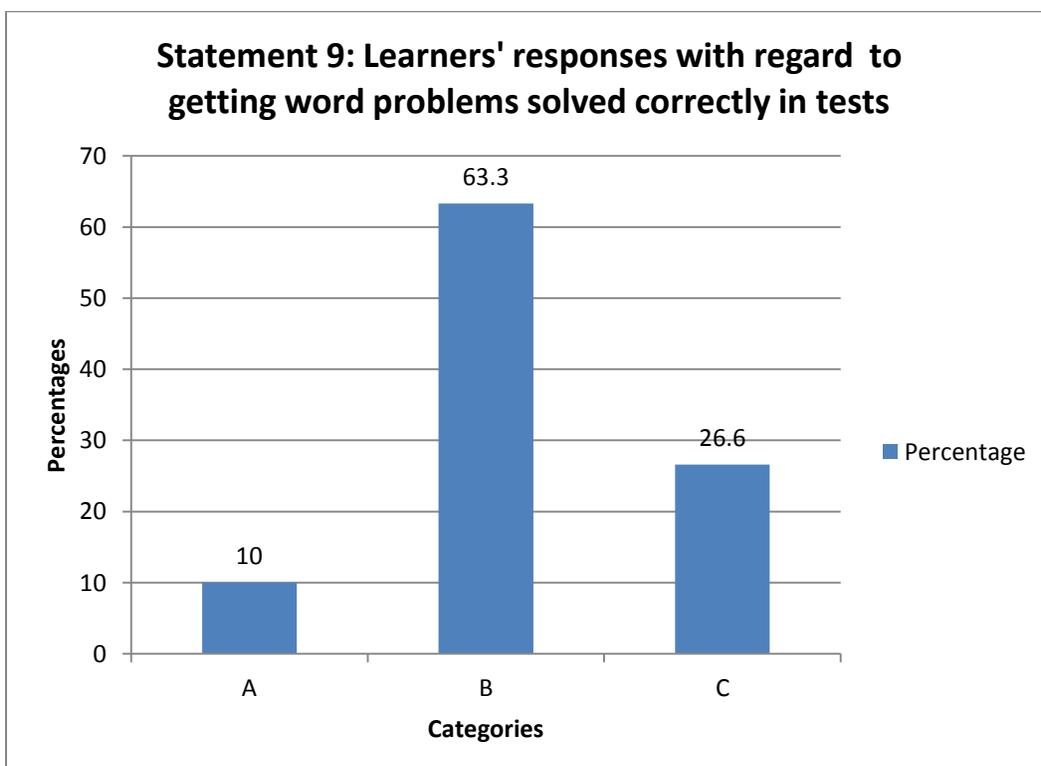
About 20% of the learners confirmed that word problems are always part of their assessment as expected from the curriculum framework from the Department of Education. This is echoed by Opolot-Okurut (n.d) who suggested that the other factors that could affect learners’ opportunities to learn mathematics are the personality of the teacher, the characteristics of the pupils, the overcrowded classrooms, the nature of the curriculum and the syllabus, the government policies on education and the learning environment and assessment methods.



**Figure 8:** Statement 8: Learners’ responses with regard to answering word problems in given tests

In response to answering word problems in tests given, only 3.3 % said that they did not answer them at all. A proportion of 43.3% mentioned that they answered word problems sometimes and 53.3% mentioned that they have always answered word problems in tests that were given.

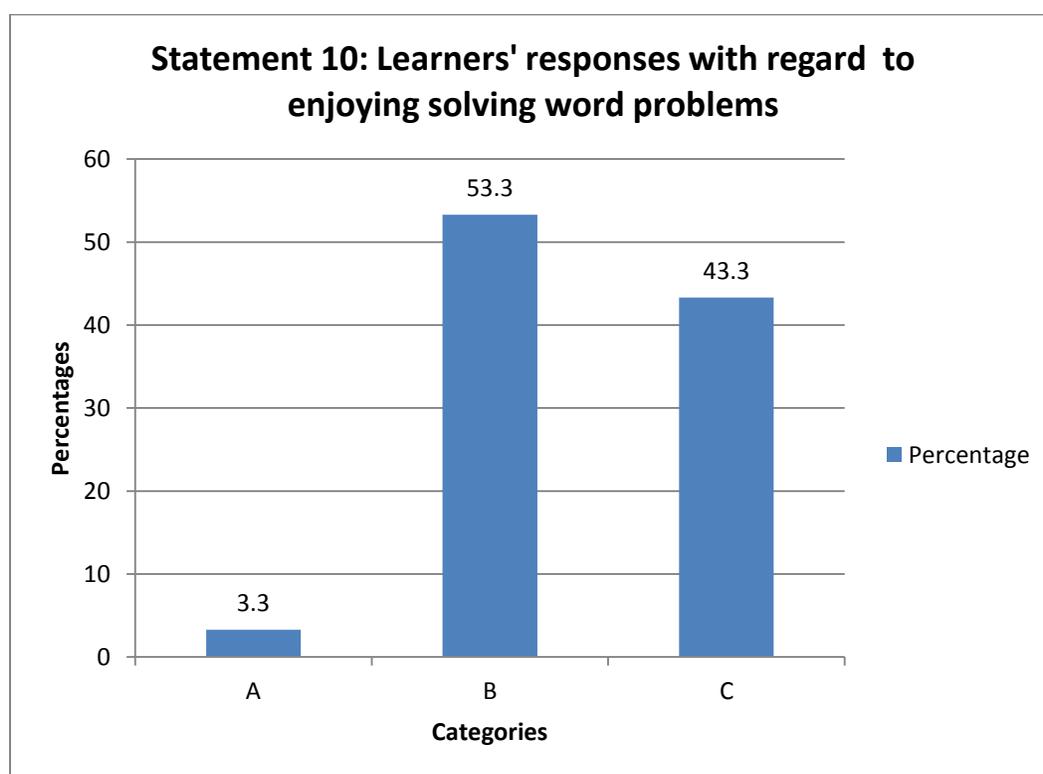
About half of the learners admitted that they sometimes answer word problems given if they ever do and even those who answer them most of the time they get them wrong or partially correct. This is alluded to by Mundia (2012) who suggested that the following factors are problems to many students learning mathematics: learners who are negatively influenced by the stereotypical beliefs held by many people that mathematics is a difficult subject, unsatisfactory teaching and the resultant lack of experience of success, and learners who unfortunately may have a genuine specific learning disability in mathematics. The findings showed that learners did not fail because they did not write the tasks.



**Figure 9:** Statement 9: Learners' responses with regard getting word problems solved correctly in tests

For this statement, a minority of ten per cent of the 30 learners responded that they did not get word problems solved correctly in tests at all. On the other hand 63.3% reported that they sometimes solved word problems correctly in tests while 26.6% of the learners said that they always solve word problems correctly.

The findings reveal that more than 70% of the learners do not get word problems correct. Joy (2013) and Botes and Mji (2010) suggest that the barriers to learning mathematics include the learning of writing symbols, understanding mathematical concepts and inadequate knowledge of the basic vocabulary. Other difficulties include not understanding mathematical language, difficulty in transferring knowledge or connecting information and experiencing spatial, perception and visual difficulties.



**Figure 10:** Statement 10: Learners' responses with regard to enjoying solving word problems

With regard to learners enjoying solving word problems in mathematics, the following responses were recorded: 3.3 % did not enjoy it at all, 53.3 % admitted to enjoy it sometimes while 43.3 % mentioned that they always enjoyed solving word problems.

Over 90% of the learners in this study admitted they sometimes or always enjoyed solving word problems. However their mark attainment from the WPT did not reflect any kind of enjoyment. It seemed that they are faced with the challenge of English language fluency. The importance of language as a factor that affects learners in the development of understanding and supporting problem solving in mathematics is emphasised by Pugalee (2001) and Sarmini (2009) and as a result, learners are likely to make numerous errors when they encounter inconsistent language problems (Xin, 2007).

## 4.4 THE TEACHERS' CLASSROOM OBSERVATION SCHEDULE

The following section provides the interpretation of data obtained through the classroom observation schedule.

### 4.4.1 Results and analysis of the classroom observation schedule

A classroom observation schedule for the two teachers was used to understand their instructional practices in their respective classrooms. This was a qualitative data collection instrument. This complemented the results on the performance of the learners on the written test to cross-validate the result findings. The observations were done twice a week and in some instances it was done once for each teacher for four consecutive weeks. The time schedule was randomly selected for each day depending on the contact periods when the teachers had mathematics lessons. The observation schedule resulted in qualitative data on the teaching and learning word problems in mathematics. The checklist on the observation covered aspects on curriculum, methodology, and content, teaching exercises, organizational issues assessment and support in the four weeks of observation. Each teacher was observed individually.

### 4.4.2 Qualitative discussions on the teaching and learning of word problems in mathematics

#### a) Curriculum:

Both teachers covered solving word problems in the topics that I observed as per the Curriculum and Assessment Policy Statement (CAPS) requirements. Topics covered during the researcher's observation periods for both teachers were:

**Addition:** example: Mr Dube buys food for a picnic. What is the total cost of the food if he buys; bananas for R 11.90; carrots for R21.70 and chicken for R48.80?( Jooste, Press, Slamang & Smuts, 2012).

**Subtraction:** example: Mrs de Bruyn plans to buy a house which costs R890 000. She has saved R288 650 and plans to apply for a loan from the bank. How much money does she need to borrow from the bank? (Jooste, Press, Slamang & Smuts, 2012).

**On percentages:** example: Jimmy's Restaurant charges its customers separate amounts for food and services. The service charge is 12% of the cost of the meal. What is the service charge if the cost of a meal is R 180? (Jooste, Press, Slamang & Smuts, 2012, p. 271).

**Measurement (length):** example: Mr Omar wants to make three jackets. He needs  $3\frac{1}{2}$  m of fabric for each jacket. He has 10 m length of fabric. Will this be enough for the three jackets? (Jooste, Press, Slamang & Smuts, 2012, p. 318).

The findings of this study observed revealed that on curriculum issues, both teachers, more often than not, provided methodology in teaching solving word problems tasks as suggested in the textbooks examples. Teachers could not come up with more innovative methodologies. Teachers casually advised learners to

use manipulates without insisting on them. Age appropriateness on the level of solving word problems was considered by both as the textbook has paced and set the level as examples.

Research has shown that there are instructional factors which necessitate that the learner learn how to critically analyse mathematical problems and produce effective solutions to problems and these are instructional strategies and methods, teacher competency (weak academic backgrounds) in mathematics education, school context and facilities (Fennema & Sherman, 1976, 1986; Epstein, 1991; Fluty, (1997) cited in Ilany and Margolin, 2010; Campbell et al., 2000; Borman and Rachuba, 2001). So, in so far as the Department of education suggests certain aspects in the curriculum, the teachers have to display initiative and competency in their teaching by varying their instructional strategies Josephine (1999) suggested factors such as the lack of appreciation, fear as well as the poor education system. The result findings suggest that teachers should be more innovative, suggest a variety of instructional strategies and the school should supply enough manipulates other than textbooks to enhance better understanding during teaching and learning.

**b) Methodology:**

Teaching strategies or methods were not varied in the teachers' teaching; mostly they used the teacher-chalkboard methods. Strategies for remembering facts were not provided, learners were left to assimilate and understand the abstractly taught facts. Real life objects were used whenever available, for instance there was hardly any banana or carrot when addition concept was taught. As far as teaching and learning is concerned, the acquiring of learning by the learners was not fully actualised as the methodology aspect was compromised from the observed results findings.

Literature suggests that the teaching methods employed in the mathematics classrooms should be learner-centred and learners should be given time to be involved in their own learning. Extra time devoted to word problem solving could also help to minimise misconceptions. Here learners demonstrate their mathematical understanding as they are involved in discussions, arguing and reasoning in order to master significant language patterns, particularly those involving subtle uses of prepositions (Haylock & Thangata, 2007). Teachers could have also made use of the mnemonics strategies which are effective acronyms that are helpful for instruction in basic facts and word problems in particular for the learners to remember taught facts. Mnemonics would help learners with memory deficiencies as they have difficulty in learning mathematical facts and remembering the correct sequence of steps for a particular mathematical skill such as memorizing the multiplication tables (Steele, 2002). Teachers must first demonstrate how the strategy works, explain the purpose of using it, model its use and help learners to memorise the steps. There is a memorisation technique of cover, copy and compare (CCC) that improves learners' performance in multiplication and division (Steele (2002); Carroll (2005); Hodge, et al. (2006); Mundia (2012)).

**c) Content:**

The two teachers could not add anything else but only taught what was in the textbook, with no fluency or confidence shown. They always referred to the book for guidance every after three to five minutes of their teaching. Identifying and explaining mathematical language was not consistent, they explained only where they knew what that term or phrase meant. They read what was in the book for the learners. What was to be done was mainly read from the book without much further elaboration.

The results of the findings illustrated that teachers had to interpret the event and phenomenon in a way that provokes the thinking of the learners (Jan & Rodrigues, 2012), which they did not demonstrate in their teaching. Teachers have to display competency, as Saritas and Akdemir (2009) suggested that factors such as gender, socio-economic status, parents' educational level; instructional factors that cover teacher competency, instructional strategies and techniques, curriculum, school context and facilities, individual factors that cover self- directed learning, arithmetic ability and motivation can affect the academic achievement of learners when solving word problems in mathematics. The resultant findings inferred that learners were taught by teachers who did not specialise in the subject during their training. This implies that even if the teacher is not competent in teaching mathematics he/she can be allocated to teach mathematics because he/she is a teacher (Opolot-Okurut, n.d).

**d) Teaching exercise:**

There was little variety in the responses that were required by the tasks. Requirements and reinforcement of the tasks and concepts during the teaching sessions were not enhanced. Learners were not taught or engaged in reading aloud and repeating instructions but mostly reading was done once by the teacher. Instructions were taken from the textbook, whether long or unclear.

The observation result findings showed that learners needed the teachers to model the task where learners would develop and use their efforts to solve a real-world word problem (Mousoulides, Christou & Sriraman, 2008). The modelling process includes describing the problem manipulating the problem, predicting the behaviour of the real problem and verifying the solution in the context of the real problem. As such, for learners to develop and actualise their potential, they need to be fully involved in their learning. Learners had to be asked to read, identify key words, understand and explain what the task needs them to do before they compute it. Learners needed the teachers to lead and engage them in reading explicit instructions because these learners rely on the key words for their understanding; otherwise they misinterpret the word problem and compute wrong answers (Jan & Rodrigues, 2012).

**e) Organisational issues:**

The logical sequence demonstrated in the teachers' teaching had been paced by the CAPS framework and textbooks used. Teaching materials were used if available. No extra effort was made to access equipment that was out of the teacher's reach, such as the fabric when teaching measurement (length). All learners

were taught as the same, no differentiation was demonstrated for learners who experienced barriers or learners who were gifted and finished way ahead of the whole class.

The findings above could be made better by the teachers adopting the findings of the study by Fuchs, et al. (2008), who suggested a conceptual and strategic instruction intervention that can alleviate the difficulty in solving word problems whereby the educator provides scaffolded instruction in solving the story problem along with instruction on identifying and integrating transfer features, using role-playing, instructional posters, modelling, guided practice and manipulatives. The strategy comes in seven steps: instructional explicitness, instructional design to minimize the learning challenge, strong conceptual basis, drill and practice, cumulative review, motivators to help students regulate their attention and behaviour to work hard, and ongoing progress monitoring.

**f) Assessment:**

Assessment was seldom done orally, but after learners were taught, they were engaged in written activities in the textbooks. Only when preparing for the formal assessment that was to be written in the following week was oral informal assessment done. Both teachers sometimes re-visited the tasks if the learners showed lack of understanding. The concern for the teachers was in finishing the syllabus or set work. Learners were never engaged to answer or solve word problem tasks in smaller groups other than for the whole class group as suggested by Mercer and Sams (2006). According to Mercer and Sams, peer group interaction is where learners work in pairs or groups and it has potential value for helping learners to relate their developmental understanding of mathematical ideas. Peer group interaction serves as a tool for learners to talk more effectively in solving word problems as on some days feedback was given on completed tasks and on some it was not given by the teachers but postponed to the following day.

**g) Support:**

The classroom observation result findings revealed that homework was hardly given because learners often did not do it and gave as reasons that they did not understand the work given. The teachers had an acceleration programme that they called a “remedial programme” in place as it was required by the School Management Team (SMT). The school required every teacher to have a programme to alleviate the high failure rate in the school. This programme not only accommodated learners who lack the word problem solving skills but also other aspects covered in mathematics. The remedial programme could not help the learners with difficulties in word problems much because the tasks were in English, which emerged as a barrier to these learners. No special worksheets with appropriate print sizes for developmental stages of the learner were used, but only the same textbook for everyone was used. No opportunities for collaborative or group work were offered.

Literature revealed that factors such as the nature of the curriculum and the syllabus, the government policies on education and the learning environment and assessment methods, leadership, organisation, management, decision-making within the school hierarchy and communication could further affect learners’ opportunities to learn mathematics (Opolot-Okurut, n.d & Sepeng, 2013).

## 4.5 INTERVIEWS

This section presents interview information.

### 4.5.1 The Learners' Focus Group Interview

For this study, the learners' focus group data are analysed through the use of semantic analysis. Thematic analysis was useful because it provided the descriptive presentation of qualitative data. To minimise the risk of losing participants' information and exposure each participant in the interview was given a pseudonym. Participants were referred to as R1, R2, and R3, up to R8. The following are learners' responses to the focus group interview:

#### 1. What are the problems that you experience when you solve word problems?

Extract 1

*R4: "Reading and understanding the question"*

*R2: "Reading and understanding the sentence"*

*R3: "Adding the numbers"*

*R1: "Reading and putting the number that is correct"*

When asked about challenges that are encountered during word problem-solving, the majority of the learners referred to reading as a major problem that seems to lead to poor interpretation of what the statement requires of them. In fact, it appeared that learners' poor reading skills was a key factor in learners' ability to make sense of the WPTs. They could not, as in reports by Sepeng (2013a), understand what the question demanded from them in order to be good problem solvers.

Learners' word problem solving approaches were also tested. The question was aimed at revealing why learners solve word problem tasks the way they do. Moreover, more light needed to be shed regarding a structure of assessments. Learners (see extract 2 below) alluded to the fact that they did not have a specific way of solving word problems, except that they modelled all the problems dealt with in class by the teacher.

Extract 2

*R7: "Because the teacher told us about examples"*

*R6: "Just read the question"*

*R1: "I wrote because I understood"*

*R8: "I wrote what the teacher told us from school"*

#### 2. How do solving word problems affect your academic achievements?

Extract 3

- R2: *“I was going to fail the test”*
- R3: *“I was going to fail the exam”*
- R8: *“I was going to repeat the class”.*
- R4: *“You will leave the school”*
- R6: *“You will fail”*

Most of the learners alluded to negative consequences towards their academic achievements if word problems are not solved appropriately. These learners’ experiences are associated with fear to fail tests or exams, repeating classes and even becoming drop outs, as mentioned by Josephine (2013). Learners’ failure or lack of success leads to loss of motivation, which results in carelessness and inattention problems in solving word problems, thus affecting their academic achievements (Steele, 2002).

### **3. What can the teachers do in order to help you understand solving word problems better?**

Extract 4

- R6: *“I need the teacher to repeat the question”*
- R3: *“To call the parents”*
- R8: *“You ask the teachers to give morning classes”*

Learners realised that teachers have to do something in order for them to better understand solving word problems. From the construct theoretical perspective, teachers have to interact with the learners about a problem solving situation to enhance learners’ understanding. Sepeng’s (2013) view of leadership, organisation, management, decision-making within the school hierarchy and communication, taken as important factors in teaching learners how to solve word problems is necessary and crucial. Probably teaching strategies and / or techniques such as code-switching, translation, re-voicing might draw on and promote the use of home language of learners to enhance understanding in mathematics classrooms (Sepeng, 2014). Amongst other things, the learners need parents to be part of their learning, special programmes to give them more time to learn, such as “morning classes” as well as the teachers to be explicit when teaching by repeating questions and instructions. Teachers should guard against sloppy and careless use of mathematical language which might lead to learners misunderstanding what is taught (Haylock & Thangata, 2007).

### **4. What do you think you need to do as learners in order to understand solving word problems?**

Extract 5

- R2: *“We need to revise at home”*
- R6: *“To do your homework”*

- R5:            *“To do corrections”*
- R4:            *“To read at home”*
- R1:            *“To revise the task at home”*
- R8:            *“To do activities”*

Almost 70% of the respondents articulated that they should do some kind of work at home, either to revise their work, revise given tasks, read about mathematics (word problems), as well as doing their homework. Sepeng (2013) argued that teachers seem not to offer the learners enough exercises to enhance components of problem solving such as decoding and interpreting, yet they have a part to play in the process of teaching and learning. Learners have to be active in constructing their own knowledge and social interactions as they are important to knowledge construction (Woolfolk, 2007). The family structure, parents’ educational level, parent and student attitudes toward school and parent involvement (Fennema & Sherman, 1976, 1986; Epstein, 1991; Margolin, 2010; Campbell, Hombo, Mazzeo, 2000; Borman & Rachuba, 2001) can help as parents and siblings can help the learners to do their homework and in that way, improve the learners’ academic achievements.

##### **5. How do you feel about learning solving word problems?**

- R3:            *“I feel good because it is easy”*
- R7:            *“I feel good because it gives me more practice”*
- R2:            *“I do not understand it because I do not learn at home”*
- R8:            *“I feel bad because there are too many instructions*
- R4:            *“I feel happy because we are revising the tasks at home”*
- R5:            *“It feels good because we do tasks at home”*

The majority of the learners, when asked about how they feel, perceive solving mathematical word problems, responded that they enjoy, like and feel good about it. However, the results from this study on WPT illustrated the negative influence of the stereotyped beliefs held by many people that mathematics is a difficult subject was further alluded to by Mundia (2012) because more than 90% obtained less than Key 3 (40%) which is a pass according to the Department of Education standard. Also the results in this study differ from a study done by Kenneth (1991) who reported that learners appeared to like solving word problems in mathematics the least.

#### 4.5.2 The teachers' individual semi-structured interviews

The data that was collected from the two mathematics teachers was qualitative, being obtained through interviews. Qualitative data are non-numerical data that have not been quantified and they result from collection of non-standardised data that require classification and are analysed through the use of conceptualization (Saunders, Lewis & Thornhill, and 2009: p.516). Qualitative data can be analysed using tools like summarizing data, categorising data and structuring data using narrative to recognize relationships, develop and test propositions and produce well-grounded conclusions, (Saunders et al., 2009: p.516).

The qualitative data that was collected from the mathematics teachers was analysed through summarising the data and structuring the data using narrative to recognize relationships.

**Table 5:** Teachers' perceptions of factors that influence learners' academic achievements in solving word problems in mathematics

Item Number	Question	Respondents (R)
01	<p><b>i. In your experience, what are the factors that affect the Grade 6 academic achievements in mathematics solving of word problems?</b></p>	<p>R9: "The language barrier, the ability to read and understand English, specifically mathematics terms that we use. Other factors are the difficulty in interpreting the story as a real event in their imagination; to actually see and visualise what is happening. To take the understanding and putting it into number sentences especially as they need to remember operations in mathematics. They do not know what exactly division is, what happens when you divide, what happens when you add, subtract, multiply. The child's background or happenings in their lives at home".</p> <p>R10: "They fail to understand the language is caused by the fact that English is not their mother tongue. They fail to apply problem solving skills. They confuse the different operations that they need to use when solving word problems."</p>

The result findings from this study summarised from the mathematics teachers' interviews showed that teachers taught the solving of word problems and learners were exposed to them as such. When teachers were asked about their experiences of the factors that affect the Grade 6 academic achievements in mathematics solving of word problems, both teachers alluded to the English language (see item number 1) as one of the major factors that affects the Grade 6 academic achievements in mathematics solving of word problems. This is coupled with the inability to read with understanding, interpreting the story sums thus confuse operations to be used for any word problem. Passiveness of learners during teaching and

learning is manifested in their not being active participants during class conversations and teachings. The learners needed to be assisted and led into understanding of solving word problems.

Literature confirms the problem of learners with regard to the teachers' response that learners are passive in their learning, they do not engage in their learning. It is argued that highly articulate learners tend to dominate classroom discussions while low-academic achievers usually remain passive and even when they participate, their contributions are comparatively weaker and their ideas are sometimes muddled (Sepeng & Webb, 2012). This is further alluded to by Josephine (1999) who pointed out that an educator's bad attitude, poor teaching skills and lack of involvement with the learners when teaching results in poor performance of the learners in the subject. Both respondents mentioned the finding that learners mixed or confused any of the four processes or operations such as confusing a subtraction (-) and applied an addition (+) (Mundia, 2012).

**Table 6:** Problems experienced in solving word problems in mathematics classrooms

<b>Item Number</b>	<b>Question</b>	<b>Respondents (R)</b>
<b>02</b>	<b>ii. How do your Grade 6 learners answer or solve word problems?</b>	<p>R9: They struggle; they show that their understanding is not complete. They begin to interpret, but they get lost when it comes to translating the actual language into mathematical operations. The steps they use are irrelevant from what the word problem needs.</p> <p>R10: They apply any basic operation without understanding the operation needed to be used to solve the word problem.</p>
	<b>iii. What are their problem solving abilities in mathematics?</b>	<p>R9: They need to be led into understanding word problems. They need to be assisted.</p> <p>R10: They are able to identify operations that are involved in each problem solving question. They are able to read questions clearly, but fail to understand what is supposed to be done in that problem solving question.</p>
	<b>iv. How do you deal with learners who struggle to answer or solve word problems correctly?</b>	<p>R9: Because it is their weak area, I turn to read the story and then ask them to focus on the key words of the story sum, or the certain words in the story sum or a sentence that will give them a hint as to what the operation may be. Lead learners into telling me what are the operations involved. I use the step by step approach. I ask them for a mathematical interpretation. I also encourage them to visualize and use diagrams as it helps them to see what is actually happening in the story sum. Often I get them</p>

		<p>on the board.</p> <p>R10: I give them individual attention after I have taught the class. I make use of counters, posters and pictures to explain the questions well to them.</p>
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The research findings above support a study done by Haylock and Thangata (2007:1) who argued that “the particular language difficulties inherent in mathematics... relate to vocabulary, syntax, abstract and natural language, miscues in word problems and the predominance of structure over content”. This is further alluded to by Kenneth (1992), Ilany and Margolin (2010) where they state that the solutions of mathematical problems are accompanied by text and the student is faced with two languages mixed together: natural language and mathematical language. It is a challenge as most of the participants are taught in English, yet it is their second language.

The results of the findings in this study implied that learners are faced with difficulties in solving mathematical word problems most of the time. The learners often misinterpret the problem as they rely on key words and arrive at wrong answers (Jan & Rodrigues, 2012). When the teachers were asked how they deal with learners who struggle to answer or solve word problems correctly, one of the teachers (R1) mentioned that she reads the story again and asks learners to focus on the key words that will give them a hint of the operation that may be used. She further involved learners by asking them for the mathematical interpretation of the word problem given. The other teacher said that she gives learners individual attention after teaching the whole class. She further mentioned that she made use of counters, posters and pictures to explain the word problems well.

Hilton (1986), as quoted in Jamison (2000) stated that:

Mathematics cannot be learned without being understood. It is not a matter of formulae being committed to memory but of acquiring a capacity for systematic thought (p. 48).

This implies that a learner should understand the word problem in order to give a correct interpretation and correct operation. Respondent 1 mentioned that “I turn to read the story and then ask them to focus on the key words of the story sum”. That illustrated that the comprehension of the text in word problems is important as that is not only the means to convey information but it is also used to interpret the event and phenomenon in a way that provokes the thinking of the learners (Jan & Rodrigues, 2012). The last 4 questions are about Teaching and learning activities.

**Table 7:** Teaching and learning activities in solving word problems.

Item Number	Question	Respondents (R)
03	<p>v. <b>In your opinion, what should learners do in order to understand solving word problems?</b></p>	<p>R9: Use the step-by-step approach. Exercise the skill of interpreting a question, identifying, finding the skills and the possibilities of the operations; putting it into a number sentence and see if the calculation is correct.</p> <p>R10: Engage them in doing activities physically and actually involve them in discovery. They must come to the teacher if they do not understand, and ask for more clarity on the work.</p>
	<p>vi. <b>How often do you teach solving word problems?</b></p>	<p>R9: It came with every topic that we embark on, but division was a problem, I could not embark on it as it should be. Time was against us.</p> <p>R10: I teach word problems just to check their understanding in every concept that I teach.</p>
	<p>vii. <b>What are the effective strategies that you use to teach solving word problems?</b></p>	<p>R9: To engage them in group activities, where groups get together and solve word problems, and are hands on. Exposure to be hands on and discussions, to do it quickly.</p> <p>R10: Mathematics teachers should develop good approaches to teach mathematics. They should be able to use pictures and posters in teaching word problem solving. I also recommend that they use scenarios to put the concepts into context so that learners will be able to understand well. They should also use dramatization (edutains) as learners like to play when they learn.</p>
	<p>viii. <b>How do you feel about teaching solving word problems?</b></p>	<p>R9: I am not uncomfortable and I don't avoid it, but I wish there was more time, I wish one could get learners to get the mathematical concepts right and get them to explore language.</p> <p>R10: Teaching word problems in mathematics makes me feel good because I think it integrates both teaching of mathematics and teaching of language at the same time. It also makes learners to be able to apply their problem solving skills in different ways, in the teaching and the learning of mathematics in Grade 6.</p>

The teachers' opinions on what learners should do in order to understand solving word problems included: exercising the skills of interpreting a question with the intention to identify the correct operation and calculation, getting involved in doing activities physically and in discovery adventure and last but not least, come to the teachers to ask for more clarity if they do not understand.

One of the teachers (R9) mentioned that she found engaging learners in group works effectively as a teaching strategy in solving word problems. She exposed the learners to hands-on and discussions. The other teacher (R10) found dramatization to be effective as learners enjoy playing and also the use of pictures and posters as they learn. From the constructivism perspective theory, learners have to be active in constructing their own knowledge and social interactions enhanced as they are important to knowledge construction (Woolfolk, 2007).

Other factors arising from literature are that the teachers themselves use mathematical language carelessly and in a confusing way, such as using the word "sum" to refer to a calculation other than addition. The importance of language as a factor that affects learners in the development of the understanding and supporting of problem solving in mathematics is emphasized by Pugalee (2001) and Sarmini (2009) and as a result, learners are likely to make numerous errors when they encounter inconsistent language problems (Xin, 2007).

With regard to Item 3 (g) on effective strategies suggested by the teachers that they use to enhance solving word problems, the authors had stated that problem solvers may use concrete or semi-concrete external representations in the form of pictures to facilitate and evoke internal representations for the problem. Learners can be motivated to be self-regulated.

R 9 felt that more time would help where learners would be engaged to explore English Language more in order to master the mathematical concepts and enhance understanding. On the other hand, R10 felt good regarding teaching word problems because it integrates both mathematics and language. She further mentioned that it enables learners able to apply their solving skills in different ways in the teaching of mathematics and word problems in particular in Grade 6.

Taylor (2005) stated that

It all takes time to help students acquire a concept and definitions. Once understood, however, symbolic algorithms seem to take relatively little time to develop—and when asked to solve computational story problems, students seem to have little difficulty in understanding the embedded relationships, numbers and operational procedures to be used (p.2).

Literature supports the findings of this study as it is mentioned that extra time devoted to word problem solving could also help in minimising misconceptions. Here learners demonstrate their mathematical understanding as they are involved in discussions, arguing and reasoning in order to master significant language patterns, particularly those involving subtle uses of prepositions (Haylock & Thangata, 2007).

This implies that time is a factor that affects the academic achievement of learners doing mathematics in word problem solving. It is also stated that low-achieving learners often do not get the chance to work on problems that stimulate their interest as they lack the "readiness" skills required for solving

the word problems in spite of their teachers offering them interesting word problems to solve (Conrad & Serlin, 2006) so that they can be active participants in their own learning. They will select, implement and monitor from a repertoire of strategies in goal oriented activities (Pape & Wang, 2003).

#### **4.6 CONSOLIDATION OF MAIN RESULTS**

The consolidation of the results of the findings of this research study was done on both the learner level and the teacher level. Results will be drawn from the finding of all the data collection techniques that were used in the study, word problem solving task (WPT), learner questionnaire, learners' focus group interviews, teachers' face-to-face interviews as well as the teachers' classroom observation schedules. The data will be quantitative and qualitative. The findings are meant to respond to the following research questions:

- i. What are the factors that affect learners' poor academic achievement in Grade 6 mathematics word problems?
- ii. How do learners solve word problems?
- iii. What are the learners' problem-solving abilities?
- iv. What pedagogies do teachers employ when teaching word problems?

##### **4.6.1 Learner level**

###### **a) What are the factors that affect learners' poor academic achievement in Grade 6 mathematics word problems?**

At learner level the following result findings emerged as factors that affect their poor academic achievements:

- I. Learners had an English language barrier.

Learners encountered difficulties in understanding and interpreting the tasks. The findings illustrated that the learners found the combination of reading, writing, reasoning, and mathematical skills required by word problems challenging. The findings that emerged from this study implied that learners did not comprehend the text, thus they could not interpret what was required of them to do because they have a language barrier. Learners had difficulties in identifying and interpreting the terms and words in the word problem.

This was evident from the word problem task (WPT). In WPT 1 (addition), 90% (27) of the responses were mathematically correct, while only 10% (3) were incorrect. In WPT 2, 17% (5) of the responses were mathematically correct or partially correct and 83% (25) were inaccurate.

From the questionnaire statement 6, the learners had a barrier to learning writing symbols, understanding mathematical concepts, inadequate knowledge of the basic vocabulary and difficulty in transferring knowledge or connecting information and having spatial, perception and visual difficulties.

From the interview with the learners, it emerged that learners' poor reading skills was a key factor in learners' ability to make sense of the word problems.

## II. Instructional factors that cover teacher competency, instructional strategies and techniques

Teachers were not explicit when teaching as learners needed them to repeat questions and instructions according to the learners' interview responses. Learners were not armed with specific ways to solve word problems, except that they modelled all the problems dealt with in class by the teachers. Learners' failure or lack of success leads to loss of motivation, which results in carelessness and inattention problems

## III. Absenteeism

From the learners' questionnaire findings, absenteeism from class could also have contributed to the learners not performing in an acceptable way. Possible underlying factors that may have affected the academic achievement of learners in mathematics in word problems could have been family structure, parents' educational level, and parent and student attitudes toward school and parent involvement.

### **b) How do learners solve word problems?**

Learners solved word problems in different ways but most of them were incorrect and inappropriate.

#### I) Learners did not take into account the real-world aspects of the problem context

Learners failed to apply the correct operation needed for the task. In WPT 3, learners used a plus sign instead of the multiplication ( $\times$ ) sign in order to get a product. In WPT 2, only 17% (5) of the responses were mathematically correct or partially correct and 83% (25) were inaccurate. For WPT 2, learners could not identify that the phrase "how many...have before" needed a subtraction operation. Learners' demonstrated lack of representations based on the learner's real-world knowledge.

#### II) Computation errors

Learners did not show any reasoning skills when applying their operations. Learners obtained computationally incorrect and situationally inappropriate answers. The learners could not re-group the tens, carry the one ten from the units and add it to the tens to make it ten tens instead of the nine tens registered. Learners were also frustrated by problems that are complex and multistep. In other responses either wrong units or no units at all were given.

#### III) Lack of learning techniques

From the observation findings, teachers casually advised learners to use manipulates and mnemonics strategies. From the focus group interview, learners illustrated a lack of a model. They mentioned that

they did not have a specific way of solving word problems, except that they modelled all the problems dealt with in class by the teacher.

From the Test, the overall findings illustrated that twenty eight (93.3 %) learners out of the 30 attained Key 1 (00% - 29%), one learner (3.3%) attained Key 2 (30% - 39%) while the last one (3.3%) attained Key 3 (40% - 49 %). The progression requirement, as per the Department of Education (2012) stipulates that in a primary school, a learner must attain a minimum mark of level 3 (40%) in mathematics in order for him or her to progress to the next class. This implies that any failure to secure key three in mathematics of which word problem solving is a part, the learner will not be able to progress to the next level.

#### **4.6.2 Teacher efficiency level**

##### **a) What are the factors that affect learners' poor academic achievement in Grade 6 mathematics word problems?**

###### **I) English language**

From the teachers' point of view, from the results gathered from their interviews, learners had an inability to read with understanding. Interpreting the story sums thus confuses operations to be used for any word problem. Passiveness of learners during teaching and learning is manifested in their not being active participants during class conversations and teachings. The learners needed to be assisted and led into understanding solving word problems.

###### **II) Instructional strategies and methods; teacher competency**

From the researcher's observations, teachers could not suggest more innovative methodologies. They casually advised learners to use manipulatives without insisting on them. Teachers taught what was in the textbook, with no fluency or confidence shown. They referred to the book for guidance after every three to five minutes of their teaching. Teachers did not model the task convincingly to the learners so that the learners do not ask the teachers to keep on repeating the question as they did. No differentiation was demonstrated for learners who experienced barriers or learners who were gifted and finished way ahead of the whole class.

###### **III) Assessment**

The result findings from the classroom observations showed that assessment was seldom orally done by teachers. However this contradicts the findings from the learners' questionnaire, statement 7, where about 90% of the learners confirmed that word problems are always part of their assessment. The teachers' concerns were in finishing the syllabus or set work. Learners were never engaged to answer or solve word problem tasks in smaller groups.

###### **IV) Time**

Teachers felt that learners would be engaged to explore English language more in order to master the mathematical concepts and enhance understanding, so more time was needed to do that. The need for time was also raised by the learners when they felt that teachers should organize morning classes to teach them. So, the issue of time was raised at both learner and teacher level.

**b) How do learners solve word problems?**

Teachers confirmed the learners' results on WPTs that learners struggle to answer or solve word problems correctly. The steps learners use are irrelevant to what the word problem needed. They begin to interpret, but they get lost when it comes to translating the actual language into mathematical operations.

**c) What are the learners' problem-solving abilities?**

According to the teachers, learners need to be led into understanding word problems. They need to be assisted because they struggle with understanding. R9, in the interview confirmed that learners can read but they fail to comprehend what they are reading. R10 further mentioned that learners are able to identify operations that are involved in each problem solving question. However this reveals contradiction with the results from the learners' performances in the WPT as they confused operations.

**d) What pedagogies do teachers employ when teaching word problems?**

From the teachers' interviews, they said they found engaging learners in group work as an effective teaching strategy in solving word problems. However, during the researcher's observation period, learners were never engaged in smaller groups except when a class is taken as a group. R9 mentioned exposing the learners to hands-on and discussions. Still, this was seldom done during the researcher's observations. The other teacher (R10) found dramatization and also the use of pictures and posters to be effective as learners enjoy playing as they learn. The researcher observed the use of some picture and other manipulates but dramatization was never observed.

#### **4.7 SUMMARY**

This chapter described the results and discussed the findings from the research and the discussions. The data analysis methods and interpretation of the data framed by both literature and theories was discussed in Chapter 2. The instrumentation techniques used to gather and analyse data were a word problem solving task (WPT), learner questionnaire, teachers classroom observation schedules, a focus group interview for the learners as well as face-to-face interviews for the teachers. Data was analysed quantitatively and qualitatively using tables, bar graphs and summaries. This chapter was concluded by referring to the consolidation of the main results under the study. Chapter 5 gave the conclusions from the results based on the findings. Recommendations are also discussed within the framework of the main research question of the study.

## CHAPTER 5

# CONCLUSIONS AND RECOMMENDATIONS

## 5.1 INTRODUCTION

This chapter presents conclusions based on the summary of results within a framework of literature and theories underpinning the study. In addition, the recommendations for both teacher practice and policy designers are discussed using the evidence collected during the study.

The primary aim of this study was to respond to the following research questions:

- i. What are the factors that affect academic achievement in Grade 6 mathematics classrooms in word problem solving?
- ii. How do learners solve word problems?
- iii. What are the learners' problem-solving abilities?
- iv. What are the effective teaching and learning strategies that can be employed to remedy the identified factors and /misconceptions?
- v. What teaching strategies do teachers employ when teaching word problems?

Against this background, the present this chapter will respond to these research questions based on the data collected.

## 5.2 SUMMARY OF FINDINGS FROM LITERATURE

Literature confirms that learners find it very challenging to understand and effectively solve word problems in mathematics because they are taught in English, yet the English language is their second language. It has been confirmed in other studies conducted by Kenneth (1992), Ilany and Margolin (2010), who stated that the solution of mathematical problems is accompanied by text and the student, is faced by two languages mixed together: natural language and mathematical language. Solving word problems involves calculation tasks that are embedded in the text and whose words and structure create problems that are called word problems (Reikas, 2009).

On a different note, Steele (2002) asserts that memory deficiencies cause learners to have difficulties in learning mathematical facts and remembering the correct sequence of steps for a particular mathematical skill such as memorizing the multiplication tables.

Findings from another research study that was conducted on other demographic factors that may affect the academic achievement of learners in mathematics in word problems indicate that gender, family structure, parents' educational level, parent and student attitudes toward school and parent involvement (Fennema & Sherman, 1976, 1986; Epstein, 1991; Fluty, 1997, cited in Ilany and Margolin, 2010: p.2; Campbell et al., 2000; Borman & Rachuba, 2001). There are also instructional factors which necessitate that the learners learn how to critically analyse mathematical problems and produce effective solutions to problems. These are instructional strategies and methods, teacher competency (weak academic

backgrounds) in mathematics education, school context and facilities. On the other hand Saritas and Akdemir (2009) categorise the factors in mathematics achievement into three divisions; demographic factors that cover gender, socio-economic status, parents' educational level; instructional factors that cover teacher competency, instructional strategies and techniques, curriculum, school context and facilities; and individual factors that cover self- directed learning, arithmetic ability and motivation. This clearly indicates that problems faced with learners are also extrinsic such as instructional strategies and teachers' competency, parental problems and problems from the department of education.

On the other hand Josephine (2013) pointed out that an educator's bad attitude, poor teaching skills and lack of involvement with the learners when teaching results in poor performance of the learners in the subject.

### **5.3 SUMMARY OF FINDINGS FROM THE STUDY**

Based on the findings of this study, the academic achievements of learners in Grade 6 classrooms in solving word problems is affected by a number of factors. This section provides answers from the empirical evidence that was interpreted within the literature review as well as theories underpinning the study.

#### **1. What are the factors that affect academic achievement in Grade 6 mathematics classrooms in word problem solving?**

In SFS (pseudo) School, the school that the researcher was studying, the performance of learners in solving word problems is negatively affected by factors such as English language as the medium of teaching and learning. This is because English language is their second language. Learners struggle to comprehend text and identify questions that need to be answered (Krick-Morales, 2006). Krick- Morales (2006: p.3) further asserts that "If a student is learning English as a second language, he might not yet know key terminology needed to solve the equation". From the teachers' point of view, learners struggled with understanding when reading the word problems and eventually the learners' experience difficulties in solving the word problems.

In this study other factors that affect the academic achievements of Grade 6 learners when solving word problems are demographic factors that are coupled with the family structure, parents' educational levels as they tend not to effectively support their children with homework, instructional teaching methods employed by the teachers, difficulties in learners in transferring knowledge, connecting information to enhance the solving of word problem. With regard to the learners being assisted by parents or siblings to do mathematics homework and assignments, 3.3% were not at all helped by their parents or siblings. Half of the respondents were sometimes helped whilst 46.6% claimed that they were always helped at home by their parents or siblings. This the findings in this study concur with those conducted by (Fennema & Sherman, 1976, 1986; Epstein, 1991; Fluty, 1997, as cited in Ilany and Margolin, 2010: 2; Campbell et al., 2000; Borman & Rachuba, 2001), who discovered that parents' educational levels, parent and student attitudes toward school and parent involvement can be factors that may affect the academic achievement

of learners in solving word problems in mathematics. On a different note Saritas and Akdemir (2009) assert that instructional factors that cover teacher competency, instructional strategies and techniques, curriculum, school context and facilities negatively affect learners' performances.

The other factor that affects the academic achievement of learners is instructional, which relate to teacher competency, instructional strategies and techniques, curriculum and methodology. From the researcher's observations schedule, teachers could not create more innovative methodologies. They casually advised learners to use manipulates without insisting on them. Teachers taught what was in the textbook, with no fluency or confidence shown. They referred to the book for guidance after every three to five minutes of their teaching. In my observation, the teachers did not model the tasks convincingly to the learners so that the learners do not ask the teachers to keep on repeating the question as they did. This was probably coupled with the low level of understanding amongst the learners. There was no differentiation for learners who experienced barriers or learners who were gifted and finished way ahead of the whole class.

In this study, the teachers were concerned when interviewed about the passiveness of the learners during teaching and the learners were not active participants during class conversations and teaching. The learners needed to be assisted and led into understanding solving word problems. This confirms literature findings that stated that low achievers in academics usually remain passive and even when they participate, their contributions are comparatively weaker and their ideas are sometimes muddled (Sepeng & Webb, 2012).

The results of findings from the classroom observations showed that assessment was seldom orally done by teachers. However, this clashes with the findings from the learners' questionnaire, statement 7, where approximately 90 % of the learners confirmed that word problems are always part of their assessment. The teachers' concerns were in finishing the syllabus or set work. Learners were never engaged to answer or solve word problem tasks in smaller groups.

Teachers felt that learners would be engaged to explore the English Language more in order to master the mathematical concepts and enhance understanding, so more time was needed to do that. The need for time was also raised by the learners, who felt that teachers should organize morning classes to teach them. So, the issue of time was raised at learner and teacher level.

## **2. How do learners solve word problems?**

The study made use of a word problem solving task (WPT) and one of the questions that the learners answered was question 6, which was based on a division, multiplication and subtraction word problem. Out of the 30 learners who wrote the test, 8 learners (27%) gave correct or partially correct responses, 22 (73%) gave inappropriate responses and no learners left blank spaces. Learners answered in the following way; they added all the figures given, subtracted all the figures, worked out without any operation and did not show any workings. Learners also failed to regroup when adding and subtracting. They had difficulties with relationships between units, tens, and hundreds. They confused division with either addition or multiplication and had difficulties in using any two of the four operations (+, -, x, ÷). Learners often do not answer word problems and they do not get them correct in assessments. The findings above on error analysis proved what Mundia (2012) came up with as errors that are committed by learners when solving word problems.

### **3. What are the learners' problem-solving abilities?**

The findings of the study indicated that the learners can read but fail to understand and interpret what they have read. Most of the learners could identify the addition (+) operation that is needed when given a word problem. This is evident from the findings on question 1 of the task given to learners, which was based on addition. All together 27 out of 30 learners got the sum either correct with the full two marks or they got partial marks.

### **4. What are the effective teaching and learning strategies that can be employed to remedy the identified factors and / misconceptions?**

From this study, not many findings indicated effective teaching and learning strategies for remedying identified factors that can be generalised. This needs further research to apply what the teachers have been using as their methodology in teaching word problems over time to see if it works before we can generalise the findings. One of the findings of this research indicates that one of the teachers felt that more time will enhance better understanding of word problems in learners and this will minimise misconceptions.

From the findings of this study, the collaboration between home and school where parents help learners do their homework has come as an effective learning strategy as learning is extended and carries on even at home, providing learners with additional explanations and direction. Teaching and learning becomes more effective when learners demonstrate their mathematical understanding as they are involved in discussions, arguing and reasoning in order to master significant language patterns as they solve word problems.

Mnemonics strategies which are helpful effective acronyms for instructions in basic facts and word problems in particular for the learners can be used. Teachers must first demonstrate how the strategy works, explain the purpose for using it, model its use and help learners to memorise the steps. There is a memorisation technique of cover, copy and compare (CCC) that improves learners' performance in multiplication and division (Steele (2002); Carroll (2005); Hodge, Riccomini, Buford and Herbst (2006) and Mundia (2012).

There is such a diverse pool of effective strategies that teachers can employ in teaching solving word problems that are highlighted by the findings and recommendations of various authors. A number of authors, Steele (2002), Carroll (2005), Hodge, Riccomini, Buford and Herbst (2006), Krick-Morales (2006, 2) and Mundia (2012), suggest the following strategies, approaches and principles to remedy difficulties experienced in solving problems: Cooperative learning: grouping learners ensures appropriate levels of instruction and enhances success. Peer tutoring or peer-mediated instruction is effective for improving calculation skills. This is a set of procedures in which learners are taught by peers through peer modelling, peer initiation training and peer monitoring. They intervene in problem presentation, instructions, error corrections and social reinforcement. Learners can also work in a team which is an effective strategy for accuracy and completion of work (p. 2-3, p.4, p. 359).

On the other hand, Fuchs, Fuchs, Powell, Seethaler, Cirino and Fletcher (2008) suggest a conceptual and strategic instruction intervention that can alleviate the difficulty in solving word problems. The educator provides scaffolded instruction in solving the story problem along with instruction on identifying and integrating transfer features, using role-playing, instructional posters, modelling, guided practice and manipulatives. On the same note Mousoulides, Christou and Sriraman (2008) explained a modelling process as a process where learners develop and use their efforts to solve a real-world word problem. The modelling process includes describing the problem, manipulating the problem, predicting the behaviour of the real problem and verifying the solution in the context of the real problem.

## **5. What pedagogies do teachers employ when teaching word problems?**

The academic achievements of learners solving word problems in Grade 6 greatly depends on the correct effective combination of the strategies above based on the relevant background of the learners in particular.

From the results of this study, the teachers used and advised learners to use manipulatives without insisting on their use. The teacher identified and explained the mathematical language inconsistently although they explained where they knew what that term or phrase meant. The above findings could be improved by the teachers adopting the findings of the study by Fuchs, et al. (2008), who suggested a conceptual and strategic instruction intervention that can alleviate the difficulty in solving word problems whereby the educator provides scaffolded instruction in solving the story problem along with instruction on identifying and integrating transfer features, using role-playing, instructional posters, modelling, guided practice and manipulatives. The strategy comes in seven steps: instructional explicitness, instructional design to minimize the learning challenge, strong conceptual basis, drill and practice, cumulative review, motivators to help students regulate their attention and behaviour to work hard and ongoing progress monitoring.

The findings from the researcher's observations were that teachers do not require learners to read aloud or repeat instructions but mostly reading was done by the teachers. The instructions were taken from the textbook, whether they were long or unclear. There was little variety in the responses that were required by the tasks. Requirements and reinforcement of the tasks and concepts during the teaching sessions were not enhanced. The research findings differed from those by Mousoulides, Christou and Sriraman (2008) who explained a modelling process as a process where learners develop and use their efforts to solve a real-world word problem. The modelling process includes describing the problem, manipulating the problem, predicting the behaviour of the real problem and verifying the solution in the context of the real problem. Both teachers sometimes re-visited the tasks if the learners showed a lack of understanding of the concept. The teachers' concern was in finishing the syllabus or set work in preference to the learners' concern for understanding what is taught.

The teachers had an acceleration programme that they called a "remedial programme" in place where the teachers taught challenging aspects to the learners, including solving word problems. This programme was required by the School Management Team (SMT). The school required every teacher to have a

programme to alleviate the high failure rate in the school. This programme not only accommodated learners who lack the word problem solving skills but also other aspects covered in mathematics.

One of the teachers mentioned that she reads the story and asks learners to focus on the key words that will give them a hint of the operation that may be used. She further involved learners by asking them for the mathematical interpretation of the word problem given. The other teacher said that she gives learners individual attention after teaching the whole class. One of the teachers mentioned that she found engaging learners in group works effective as a teaching strategy in solving word problems.

## **5.4 RECOMMENDATIONS**

The factors that affect the academic achievement of learners in Grade 6 classrooms in solving word problems is a diverse topic that draws on the issues of reading, understanding, interpreting and solving the so-called story problems. Word problems are entailed in two languages that are mixed together; the natural and the mathematical languages that need to be dissected as problems are solved. For this reason, in order for policy makers to generate achievable strategies in solving word problems in Grade 6 classrooms, there is a necessity to carry out more research at the local and national levels. The recommendations are discussed under the following aspects: the learners' academic achievement in the mathematics classrooms, teaching and learning of word problem solving in mathematics classrooms as well as the strategies that are recommended from the results of this study.

### **5.4.1 The learners' academic achievement in a mathematics classroom**

In order for the local and national government to enhance better performance in as far as the learners' academic achievement is concerned when it comes to solving word problems, the following recommendations are made:

- a) The Department of Education should train more mathematics teachers who have sufficient knowledge coupled with a variety of strategies with more emphasis on challenging aspects and topics such as the solving of word problems in mathematics. It is crucial to have these relevantly trained teachers in the primary schools as this is the foundation on which aspects have to be built on for present and future use.
- b) Parents need to create a home environment that can affect children's learning by modelling responsibility as they help them do their homework and follow up to ensure homework is done all the time. This will build self-esteem and self-efficacy in the learners. Learners will in turn be motivated and the academic expectations will not stress the learners as their performance will be better.
- c) The school must enhance and demonstrate good leadership, organisation, management, healthy decision-making within hierarchy and communication and follow up on the correct implementation of the curriculum and competency of the deliverers of the curriculum.
- d) The teachers and the school management team should promptly identify issues of maths anxiety and phobia that affect learners' social, emotional, and behavioural issues. These interfere with the

achievement of success in mathematics as learners develop feelings of dependence because they believe they cannot work without teachers.

#### **5.4.2 Teaching and learning of word problem solving in mathematics classrooms**

- a) The instructional language should be made explicit to learners so that they can comprehend and be able to interpret the word problem without difficulties.
- b) The teaching of word problem solving should be free of the misuse and sloppiness in the mathematical use of words as these can be a barrier to learners' understanding of mathematical concepts.
- c) Teachers when teaching can make use of teaching strategies and / or techniques such as code-switching, translation, re-voice which might draw on and promote the use of home language of learners to enhance better understanding in mathematics classrooms.
- d) Teach learners to apply arithmetic operations to real-life situations to get rid of the negative influence of the stereotype beliefs held by many people that mathematics is a difficult subject.
- e) The teachers should model the tasks and the learners should listen to all directions and perform all the steps in a problem and complete all the work.
- f) Learners should be engaged in the combination of reading, writing, reasoning, and mathematical skills required by word problem.
- g) Learners should be taught the mathematical vocabulary which includes technical terms, symbols, non-technical terms and words with multiple meanings and explaining should be clear.
- h) Learners have to be active in constructing their own knowledge and enhance their social interactions as these are important to knowledge construction. They should not be passive in the teaching and learning process.

#### **5.4.3 Strategies that are recommended from the results**

- a) Teachers should engage learners in working in smaller groups.
- b) Manipulates should be used and encouraged during teaching and learning to enhance better understanding.
- c) Teachers in their teaching, should engage the learners in the interaction process of acquiring new knowledge through rethinking ideas, to argue, evaluate, share, examine and understanding the conceptual underpinnings of mathematics as they become better problem solvers.
- d) A programme that would be school tailored to help the learners who experience difficulties in solving word problems. This will mean extra time for both the learners and the teachers.

### **5.5 LIMITATIONS OF THE STUDY**

This study, like most research using a mixed method research methodology inherently warrants some cautions, as it will not provide all the answers to the research question. Firstly, the level of convergence of the quantitative and qualitative methods could not be completely justified as the proportions of each of the designs are not clearly articulated when using this kind of research methodology.

Secondly, there is a limitation involving the facilitator bias of the focus group methodology. As the facilitator, the researcher is an educator who might wish that the study would cover aspects not researched and thus could tamper with the results. Nevertheless, care was taken to optimize the reliability of the findings through the use of several sources.

Thirdly, the participants in this study come from one community. Thus the results cannot be assumed to generalise in respect of other primary school populations.

## **5.6 FURTHER RESEARCH**

A further detailed study that covers more schools in different provinces is recommended before a National Programme is established in order to implement the results of this study. This is necessary so that variations among provinces are incorporated in the implementation programme. Further research should be taken upon the outcome of the results where learners said they enjoyed solving word problems and yet they did dismally on the word problems.

## **5.7 CONCLUSION**

This chapter sought to present the conclusions as underpinned by the research findings and literature to answer the research questions studied. The chapter made recommendations for future researchers, learners, teachers and the Department of Education to improve the current capacity of learners to solve word problems in the classrooms. The study concluded by the researcher stating the limitations of the study and making recommendations for further research.

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APPENDIX 1

TEST (LEARNERS)

1.1 There were originally 49 312 houses in Jefferson Township. During a housing boom, developers built 55 063 more. How many houses are now in Jefferson Township? /2/

$$\begin{array}{r} 49\ 312 \\ + 55\ 063 \\ \hline 104\ 375 \end{array}$$

1.2 The Princeton Public Library purchased 9 015 books. Now the library has a total of 38 563 books. How many books did the library have before? /2/

$$\begin{array}{r} 38\ 563 \\ - 9\ 015 \\ \hline 29\ 548 \end{array}$$

1.3 A train travels at 100km per hour. How far will it travel in 9 1/2 hours? /3/

3 hours 1

Page 4

1.4 Pedro travels to Pretoria which is 92,3 km from his home. After driving for 56,7km, he stopped for fuel. How far was he then from Pretoria? /3/

$$\begin{array}{r} 92,3 \\ - 56,7 \\ \hline 35,6 \end{array}$$

1.5 All the articles in a store are marked down by 25%. What will Thilani pay for a shirt that was marked R200 before the discount? /5/

$$\begin{array}{r} 25\% \\ 200 \times \\ \hline 105 \times \\ \hline \end{array}$$

0/

1.6 Mr Msebenzi buys 480 sweets for R30, 00. He repacks the sweets into packets of 24 each. He sells the packets for R2, 50 each. How much profit will he make if he sells all the sweets? /5/

$$\begin{array}{r} 480 \\ 30,00 \\ 24 \\ \hline 2,50 \\ \hline 37,54 \\ \hline \end{array}$$

0/

APPENDIX 2

Ethical Clearance certificate



Research Ethics Clearance Certificate

This is to certify that the application for ethical clearance submitted by

**N A T Kunene [32082932]**

for a M Ed study entitled

**Exploring the factors that affect academic achievements in Grade 6  
mathematics: A case of solving word problems**

has met the ethical requirements as specified by the University of South Africa  
College of Education Research Ethics Committee. This certificate is valid for two  
years from the date of issue.

  
Prof KP Dzvimbod  
Executive Dean : CEDU

  
Dr M Claassens  
CEDU REC (Chairperson)  
[mcdtc@netactive.co.za](mailto:mcdtc@netactive.co.za)

Reference number: 2014 JULY /32082932/MC

16 JULY 2014

APPENDIX 3

Permission to conduct research



education  
Department:  
Education  
PROVINCE OF KWAZULU-NATAL

ENQUIRIES: Dr VESikhosana

REFERENCE: Research: NAT Kunene

DATE: 23/10/2013

Mrs N.A.T.Kunene

P.O.Box 389

Kwambonambi

3915

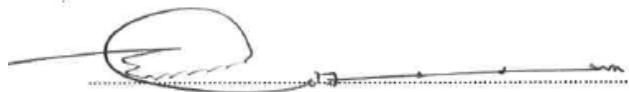
PERMISSION TO CONDUCT A RESEARCH AT SINAYE FULL SERVICE SCHOOL

The matter as mentioned supra has reference.

This letter serves the purpose of officially granting you a permission to conduct your research as per your request/application dated 3 June 2013.

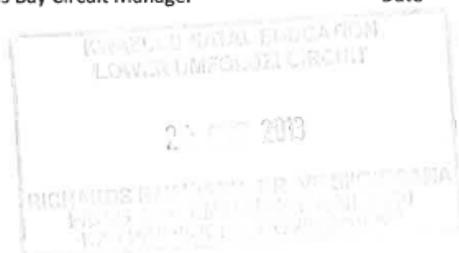
Hoping that you will be open to discuss your findings with our department and or schools to make specific marks and difference in our learners for their bright future when your research will have been finalized.

Wishing you good luck in your research and studies respectively.

 24/10/2013

Dr VE Sikhosana: Richards Bay Circuit Manager

Date



dedicated to service and performance  
beyond the call of duty

KWAZULU-NATAL DEPARTMENT OF EDUCATION: LOWER UMFOLOZI CIRCUIT MANAGEMENT  
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**APPENDIX 4**

**Classroom Observation Schedule**

**Table 8: Checklist for assessing the teaching of word problem solving**

*Did the following happen / take place:*

<b>Teaching and learning of word problem tasks</b>	<b>Respondent (R) 1 (yes, sometimes or no)</b>	<b>Respondent (R) 2 (yes, sometimes or no)</b>
<p><b>a) Curriculum</b></p> <ul style="list-style-type: none"> <li>✚ Cover solving word problem solving in all topics taught by teachers</li> <li>✚ Provide methodology in teaching of solving word problems tasks</li> <li>✚ Encourage, advise, insist on the use of manipulatives (concrete materials)</li> <li>✚ Consider age appropriateness on the level of solving word problems tasks</li> </ul>	<p>Yes</p> <p>Sometimes</p> <p>Sometimes</p> <p>Yes</p>	<p>Yes</p> <p>Sometimes</p> <p>Sometimes</p> <p>Yes</p>
<p><b>b) Methodology</b></p> <ul style="list-style-type: none"> <li>✚ Does teacher vary teaching strategies or methods in her teaching</li> <li>✚ Provide the students with strategies for remembering facts on solving word problems</li> <li>✚ Use real-life objects in her teaching</li> </ul>	<p>No</p> <p>No</p> <p>Sometimes</p>	<p>No</p> <p>No</p> <p>sometimes</p>
<p><b>c) Content</b></p> <ul style="list-style-type: none"> <li>✚ Competent in teaching solving word problems.</li> <li>✚ Identify and explain the mathematical language involved in the topics taught</li> <li>✚ Clearly explain concepts before teaching word problems</li> <li>✚ Communicates clearly and explicitly on what should be done in each WPT</li> </ul>	<p>Sometimes</p> <p>Sometimes</p> <p>Sometimes</p> <p>Sometimes</p>	<p>Sometimes</p> <p>Sometimes</p> <p>Sometimes</p> <p>Sometimes</p>

<p><b>d) Teaching exercise</b></p> <ul style="list-style-type: none"> <li>✚ Teaches WPTs in every topic</li> <li>✚ Introduce variety in the responses required</li> <li>✚ Vary the requirements of the task</li> <li>✚ Get the learners to repeat instructions</li> <li>✚ Get them to read aloud</li> <li>✚ Use short and clear instructions</li> <li>✚ Guide the learners to identify and pick key words from the WPTs</li> <li>✚ Reinforce key concepts and necessary solving skills</li> </ul>	<p>Yes</p> <p>Sometimes</p> <p>Sometimes</p> <p>No</p> <p>No</p> <p>Sometimes</p> <p>Sometimes</p> <p>Sometimes</p> <p>Sometimes</p>	<p>Yes</p> <p>Sometimes</p> <p>Sometimes</p> <p>No</p> <p>No</p> <p>Sometimes</p> <p>Sometimes</p> <p>Sometimes</p> <p>Sometimes</p>
<p><b>e) Organisational issues</b></p> <ul style="list-style-type: none"> <li>✚ Demonstrate a logical sequence in her teaching</li> <li>✚ Have necessary equipment ( teaching materials) easily available during teaching</li> <li>✚ Teaches the whole class with differentiated elements</li> <li>✚ Consider age appropriateness</li> </ul>	<p>Yes</p> <p>Sometimes</p> <p>No</p> <p>Yes</p>	<p>Yes</p> <p>Sometimes</p> <p>No</p> <p>Yes</p>
<p><b>f) Assessment</b></p> <ul style="list-style-type: none"> <li>✚ Uses a wide range of assessment tools</li> <li>✚ Informally assess before administering formal assessment</li> <li>✚ Re-visits tasks if learners show lack of understanding</li> <li>✚ Allow learners to interpret a WPT before attempting to answer it</li> <li>✚ Engage learners to answer WPTs in a group level or for the whole class</li> <li>✚ Give learners feedback on completed tasks</li> </ul>	<p>No</p> <p>Yes</p> <p>Sometimes</p> <p>No</p> <p>Sometimes</p> <p>Sometimes</p>	<p>No</p> <p>Yes</p> <p>Sometimes</p> <p>No</p> <p>Sometimes</p> <p>Sometimes</p>
<p><b>g) Support</b></p> <ul style="list-style-type: none"> <li>✚ Reinforce topics covered by giving learners homework</li> <li>✚ Have acceleration or remedial programmes for learners who lack the word problem solving skills</li> <li>✚ Make use of worksheets with appropriate print size for developmental stages of the learner</li> <li>✚ Offer opportunities for collaborative or group work</li> </ul>	<p>Sometimes</p> <p>Sometimes</p> <p>No</p> <p>No</p>	<p>Sometimes</p> <p>Sometimes</p> <p>No</p> <p>No</p>

## **APPENDIX 5**

### **INTERVIEW INSTRUMENTS**

#### **INTERVIEW GUIDE FOR THE FOCUS GROUP: (LEARNERS)**

1. What are the problems that you experience when you solve word problems?
2. What makes you to solve word problems or questions the way you have solved them in the given task?
3. How do the solving word problems affect your academic achievements?
4. What can the teachers do in order to help you understand solving word problems better?
5. What do you think you need to do as learners in order to understand solving word problem?
6. How do you feel about learning solving word problems?

#### **INTERVIEW GUIDE FOR THE TEACHERS:**

- a. In your experience, what are the factors that affect the grade 6 academic achievements in mathematics solving of word problems?
- b. How do your Grade 6 learners answer or solve word problems?
- c. What are their problem solving abilities in mathematics?
- d. How do you deal with learners who struggle to answer or solve word problems correctly?
- e. In your opinion, what should learners do in order to understand solving word problems?
- f. How often do you teach solving word problems?
- g. What are the effective strategies that you use to teach solving word problems?
- h. How do you feel about teaching solving word problems?

**APPENDIX 6 : QUESTIONNAIRE (Learners)**

**TABLE A**

Indicate with a (√) where appropriate:

	Not at all (1)	Sometimes (2)	Always (3)
1. In some days I have been absent from mathematics classes.			
2. I display high levels of discipline during the teaching and learning.			
3. I study mathematics at home.			
4. I am assisted by parents/ siblings to do mathematics homework, assignment, etcetera			
5. I enjoy learning mathematics at school			

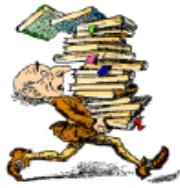
**TABLE B**

Curriculum and instructional issues in the classroom. Indicate with a (√) where appropriate:

	Not at all (1)	Sometimes (2)	Always (3)
6. I am taught how to solve word problems in my learning.			
7. I am formally assessed on solving word problems in the tests or assessments that I write.			
8. I answer word problems in tests given.			
9. I get solving word problems correct in tests.			
10. I enjoy solving word problem.			

## APPENDIX 7

### Accredited Language Editor's Report



*Astute Editing and Research*

17 November 2014

To Whom It May Concern

Dear Sir/Madam,

This is to certify that I have fully edited the MEd thesis of Ms Nothile Kunene entitled “Exploring the factors that affect academic achievement in Grade 6 mathematics classrooms: a case of solving word problems” for the University of South Africa. The text was checked for clarity and ease of reading, grammar and usage, spelling and punctuation, consistency in the use of text and figures in illustrations and tables, completeness and consistency in references, consistency in page numbering, headers and footers and suggestions were offered. The editor makes no pretension to have improved the intellectual content of the thesis and did not rewrite any text. The editor’s suggestions are to be accepted or rejected by the author. The author effected the final changes herself.

Yours sincerely,

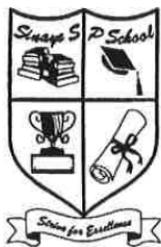
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Telephone 012-342-3518

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4 Gospel Close, 821 Church Street, Arcadia 0083, Pretoria.

**Appendix 8: Permission to grant a research at SFS School**



**SINAYE SENIOR PRIMARY SCHOOL  
FULL SERVICE SCHOOL**

Physical Address:  
Enseleni Suburb  
Uqhume Street  
Richards Bay, 3900

Postal Address:  
P O Box 7265  
Empangeni Rail  
3910

Tel: 035 795 1225  
Fax: 035 795 1299  
Email: sinaye@telkomsa.net  
principalgumede  
@telkomsa.net

23 October 2013

Mrs N. A. T. Kunene

P. O. Box 389

Kwambonambi

3915

**PERMISSION TO GRANT A RESEARCH AT SINAYE FULL SERVICE SCHOOL**

The matter as mentioned above has reference

This letter serves the aim of granting you permission to conduct your research as per your request dated 04 June 2013.

We hope that once you come up with your findings of your research, you will inform the school in one way or the other in order to make a difference in the learners we are teaching.

The school wishes you the best in your research and studies.



---

Mr T. S. Gumede  
Principal ( 076 091 1829)

## APPENDIX 9

### Turnitin Report

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