ENHANCING GRADE 4 LEARNERS' MATHEMATICAL PROBLEM-SOLVING SKILLS IN WORD SUMS

by

NTOMBIZINHLE ROSEMARY BHENGU

PTD (Appelsbosch College); H. Ed (Natal College); B.Ed. – HONS (University of Natal)

Dissertation submitted in fulfilment of the requirement for the degree

Master of Education (M.Ed.)

In the

Faculty of Education

School of Curriculum Studies

At the

University of the Free State

Bloemfontein

Supervisor: Dr T.J. Moloi

Co-supervisor: Dr M. S Mosia

July 2020

DECLARATION

I, Ntombizinhle Rosemary Bhengu, declare that the dissertation, ENHANCING GRADE 4 LEARNERS' MATHEMATICS PROBLEM-SOLVING SKILLS IN WORD SUMS, hereby submitted for the qualification of Master of Education, at the University of the Free State, is my own independent work and that this work has not previously been submitted at another university for the same or another qualification.

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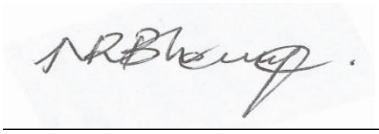


N.R. Bhengu

July 2020

DEDICATION

This work is dedicated to my husband, Thulani and my children, Sabelo, Sibongiseni, Ntobeko and Nomvuyo. I wish to extend my gratitude to you all for the love and support you gave me. Your contribution towards this study is what kept me going. You were so patient and never gave up on me even when I was down and out. Thank you so much guys, you are my pillars of strength. This hard work belongs to you all.

ACKNOWLEDGEMENTS

I wish to extend my gratitude to the following people who contributed towards the success of this study:

- God, my creator for the gift of life He gave me. I thank Him for walking by my side throughout this journey.
- My supervisor, Dr Moloi, for guiding me from the beginning till the end. Without his support this would have been impossible.
- Dr. Tsotetsi and Dr Tlali, thank you for your insightful comments and involvement. I really appreciate everything you did to make this study a success.
- Mr Mahaye, thank you for motivating me to finish this study when I was about to give up.
- My sisters, Duduzile, Zanele and Nelisiwe. Thank you for being there for me when things were tough. You gave me strength to carry on.
- My husband for allowing me his time to fulfil my dream.
- My children, Sabelo, Sibongiseni, Mndeni and Nomvuyo. This project would not have been completed without your guidance and support. Thank you so much guys.
- My nieces, Sindi, Fundi, Nonkululeko, Slindi, Samkelisiwe, Lihle and Qondi. Thank you, girls, your encouragement kept me going.
- My sister-in-law Rita. Thank you for motivating me to do this project. You are a true bricoleur “sisi”. You lifted me up when I was down and out.
- My brother-in-law Sipho, without you, bricolage was difficult to understand. Thank you so much for your contribution.
- My friend Khanyisile, you kept me going when I could not see. Thank you so much “sisi”.
- Thank you to the principal and the SGB for giving me permission to conduct the study at your school, and the entire research team.
- Thank you, “You are, therefore I am ‘’ team. The time we spent together was very fruitful. Thank you for the contributions you made towards the study. God bless you all.

ABSTRACT

The study aims to enhance problem-solving skills for grade 4 learners in word sums. According to the Curriculum and Assessment Policy Statements, mathematics helps to build up mental processes that improve critical thinking accuracy and problem-solving that will be conducive to decision-making. Focus was given to all content areas, namely: Numbers, Operations and Relationships, Patterns, Functions and Algebra, Space and Shape, Measurement and Data Handling. Each content area is aimed at equipping learners towards attainment of specific skills, such as communicating, investigating, representing and the skill of interpreting information.

The study employed Bricolage model as a lens, which according to Aagard is a process of creating something new from resources available at hand. Bricolage is suitable for this study, because it uses a variety of methods, theories and perspectives, which assisted in interpreting suggested solutions to challenges grade 4 learners are experiencing in solving word sums. The Participatory Action Research (PAR) as research approach, was adapted and utilised to enhance problem-solving skills for grade 4 learners in word sums. PAR uses a range of qualitative methods, which allow people to interact in a shared social world. The study was conducted in a primary school in Dannhauser. The research team comprised of the School Management Team (SMT) of five members, namely: Principal, Deputy Principal and three Heads of Departments, grades 5, 6 and 7 Mathematics teachers, two School Governing Body (SGB) representatives, 40 learners and myself the researcher. The research team was chosen in no particular order, but the researcher felt it was imperative for all the SMT to be part of the research, as they are the managers of the school. The SGB represented the parents and the grade 4 leaners were the researched. Mathematics teachers were responsible for designing activities on how word sums should be taught in order to enhance grade 4 learners' mathematical problem-solving skills. Critical Discourse Analysis (CDA) was used to analyse generated data.

Findings revealed that grade 4 learners' mathematical problem-solving skills in word sums would be enhanced when teachers employed the multiplicity of bricolage model that entails the multiple perspectives, multiple theories and multiple methods. This

study will benefit teachers and learners in South African schools with the teaching and learning of word sums in mathematics classrooms.

Keywords: enhancing. problem-solving skills, mathematical word sums, bricolage, Participatory Action Research, Critical Discourse Analysis.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

CDA	Critical Discourse Analysis
DBE	Department of Basic Education
DoE	Department of Education
HOD	Head of Department
LoLT	Language of Learning and Teaching
NEEDU	National Education Evaluation and Development Unit
NEP	National Education Policy
PAR	Participatory Action Research
PCK	Pedagogical Content Knowledge
SCK	Subject Content Knowledge
SWOT	Strengths, weaknesses, opportunities, threats
UNESCO	United Nations Educational Scientific and Cultural Organisation
VR	Visual Representation

LIST OF APPENDICES

APPENDIX D:

APPENDIX E:

APPENDIX F:

APPENDIX G:

CHAPTER 1 :
INTRODUCTION AND BACKGROUND TO THE STUDY

1.1. INTRODUCTION

The study aims to design a strategy to enhance mathematics for grade 4 learners' problem-solving skills in word sums. Grade 4 learners are struggling in solving word sums, because they fail to comprehend mathematical text in Language of Learning and Teaching (LoLT), Department of Basic Education (DBE, 2012:8). Furthermore, mathematics helps to strengthen mental processes that enhance critical thinking, accuracy and problem-solving that will be conducive to decision-making, which is difficult for grade 4 learners. Focus is on all content areas, namely: Numbers, Operations and Relationships, Patterns, Functions and Algebra, Measurement and Data handling, which the grade 4 learners are battling to understand. Furthermore, content areas in mathematics are designed to equip learners towards the attainment of specific skills, such as communicating, investigating, representing and skills for interpreting information. Since word sums cut across all Mathematics content areas, the researcher found it imperative to focus on all of them in the study. Van Wyk (2011:117) corroborates that learner performance in mathematics is poor due to the fact that learners lack the aforementioned skills in the subject.

Nevertheless, the challenges faced by the grade 4 learners do not take place in our country only, but this is the issue that the entire world is facing. Phiri (2014:1), in his research discovered that the Philipino children experienced the same problem with their comprehension skills in word sums in the lower grades. Not understanding the text in mathematical word sums makes it difficult for learners to decide which basic operation to use in order to compute numbers. Furthermore, Barwell (2009:2) also identified the same problem in the United States of America, as learners in the lower grades did not do well in word sums, which affected their whole performance in mathematics. According to Chitera (2011:1), learners in Lesotho lacked proficiency in the Language of Learning and Teaching (LoLT), therefore they could not solve mathematical word sums. The transition from being taught in their mother tongue in the foundation phase to English as Language of Learning and Teaching (LoLT) in the Intermediate Phase is another contributing factor to grade 4 learners in failing to

understand word sums. However, teachers are faced with a challenge of balancing mathematical language and LoLT for learners to perform better in solving word sums in particular (Essien, 2013:8). In addition, poor teaching methods in South African school's result in learners failing mathematics, because teachers rely more on textbooks than on approaches that actively engage learners for their problem-solving skills to improve.

In attempts to finding solutions to the challenges mentioned above, Bicer, Capraro and Capraro (2013:1) state that learners' mathematical reasoning first needs to be fostered. This would be made possible by developing their mathematical thinking, in a number of planned activities, which is the key element in advancing learners' problem-solving skills in a mathematical classroom. Writing in a mathematics classroom requires learners to demonstrate how and why they know things, through writing learners get an opportunity to amend their errors before the teacher does (Bicer *et al.*, 2013:1). Furthermore, through writing, teachers get to see how much learners know and immediately identify areas where learners need to be developed at. Through writing, teachers are able to monitor the learners' progress, because mathematics can never be taught abstractly. According to Jegede (2012:4) teachers divert to code-switching in cases where learners encounter difficulties in understanding mathematical text in word sums. Code-switching is when teachers give clarity on the text in learners' mother tongue to enhance their problem-solving skills. Even less capable learners' benefit in a mathematical classroom where the LoLT is put aside for a short time and switch to mother tongue to explain the text in simpler terms, and scaffold learning. However, this code-switching works for learners, especially those with barriers to mathematical language when learning word sums. Bicer *et al.* (2013:4), concur that incorporating writing into a mathematics classroom enhances learners' mathematical content and their problem-solving skills in word sums. The more learners write, the more content knowledge and problem-solving skills they gain to solve the word sums. Poch, van Garderen and Scheuermann, (2015:153) attest that an introduction of visual representation (VR) in a mathematics classroom makes it easy to learn and is a powerful tool that teachers use to support learners who struggle with number computation. Visual representation can be used as a manipulative, which according to Mokotjo (2017:52), enables the learner to infuse gained knowledge to the problem posed. Since word sums are difficult for grade 4 learners to understand, the

usage of VR will enhance their problem-solving skills in word sums, and will guide them towards the correct answer.

Success in the implementation of the strategy comes with conditions. Amongst these conditions is team-teaching, which according to MolokoMphale and Mhlauli (2014:123) is when a number of approaches are used by teachers working as a team to realise one desired goal, which in this study is to enhance problem-solving skills for grade 4 learners in solving word sums. In addition the strategy would succeed when learners are seated in groups and peer-tutoring by capable learners is applied in order to assist less capable learners in solving word sums they struggle to solve (Mazibuko, 2014:182) In peer tutoring, fast and capable learners get to address what less capable learners find difficult to understand, and they explain that content in the language they all understand. It is never enough for learners to be assisted by other learners in a mathematics classroom. Therefore, it is for this reason that teachers need to have Pedagogical Content Knowledge (PCK) to be able to impart knowledge (content) to learners (Karaman, 2012:59) in ways that enhance their problem-solving skills in word sums. MolokoMphale and Mhlauli (2014:115) attest that learners learn better when the environment is conducive and teachers' communication and social skills are such that learners feel safe and free to explore their potential. Furthermore, learners perform better when teachers speak in a warm and friendly manner, than when they are loud and harsh. Learners end up not participating in classroom interactions, because they feel they get punished or reprimanded when they answer incorrectly. The tone in the teacher's voice tells whether the classroom environment is conducive to learning or not. However, the happier the learners are in the learning environment, the more positive responses teachers get and the problem-solving skills in word sums for grade 4 learners are enhanced (Mokotjo, 2017:58)

Not everything goes well in the learning environment where teaching and learning take place. Sometimes things get messy and the outcomes are not achieved and that impedes the success of the study. Amongst the hindrances that threaten the success of the study are shortages of teaching and learning resources. Okongo, Ngao, Rop and Nyongesa (2015:135) concur when they say the quality of education in our country is elevated by the kind of resources utilised in schools. These resources entail physical resources, human resources, financial resources and teaching and learning resources, as well as many more. According to Lyons (2012), the availability of

teaching and learning resources in a mathematics classroom facilitates learning of abstract concepts and enhances learner performance. The absence of teaching and learning material can be a stumbling block in a mathematics classroom when word sums are taught. On the contrary, tangible objects or visual representation make learning easier for all learner types, and even easier for those who struggle with numbers. DBE (2012:34) shows time allocation per topic and gives the duration to cover each topic before assessment is done. This then affects learners that take too long to assimilate some mathematical concepts (Bird, 2012:113). Furthermore, less capable learners suffer when they are not given extra time to catch up where they did not master the concepts in given time, as word sums require learners to understand the text before finding the solution to it. If teachers take too much time on one topic trying to keep up with struggling learners, such endeavour may compromise the entire teaching time.

In addition, unavailability of the Subject Content Knowledge (SCK) in the teaching and learning of mathematical word sums can be the hindrance in enhancing problem-solving skills for grade 4 learners. For effective teaching to take place, teachers, however, need to have knowledge of the subject, and be able to employ a range of approaches and relevant resources that will make it easy for learners to learn word sums (Mupa & Chinooneka, 2015:125). Mosia (2016:144) contends that teachers without the Subject Content Knowledge, cannot succeed in equipping learners with the necessary skills (Hill, Ball & Schilling, 2008:563) they need to solve word sums and also to use in their life experiences. He further states that SCK entails knowledge of facts, approaches, theories and methods a teacher needs for effective teaching. Experienced teachers play a big role in assisting novice teachers with the knowledge and skills that enhance learner performances in solving word sums.

After all is said and done, evidence that indicates the success of the strategy is seen when learners are exposed to as many writing activities that foster their mathematical thinking, as well as their problem-solving skills in word sums (Bicer, Capraro & Capraro, 2011:363). They further concur that the more learners are engaged in writing activities, the more knowledge and skills they gain that enables them to grow in solving mathematical word sums. Through writing learners get an opportunity to explore their understanding and to construct meaning out of the given text in solving mathematical word sums (Blease, 2014:20). It is through learners' engagement in writing activities

that gives teachers a platform of giving feedback in the form of corrections where learners did not do well. Keeping of a journal in a mathematics classroom also benefits learners, because learners get to re-visit their work for re-enforcement purposes and for preparations of assessment and for parental involvement with the work done at home. Writing is an essential tool in the teaching and learning of mathematics, therefore teachers should make ample provision for learner involvement in group and individual activities (Blease, 2014:24) to enhance problem-solving skills in word sums.

Success of the strategy was evident where the challenging concepts were explained in learners' mother tongue for deeper understanding of the text. This was supported by Bautista, Mulligan and Mitchelmore (2009:133) in their work when they attested that Filipino children's performance in word sums improved when learners were taught in their mother tongue, compared to when they were taught in the English language. These children had difficulties in making sense of the problem, due to a lack of proficiency in the English language (Bautista *et al.*, 2009:132). As a result, teachers resorted to code- switching, so that learners would be able understand the text and be able to solve word sums. This then worked to the benefit of learners, because their performance in word sums improved. In South African schools where learners were taught mathematics in their mother tongue in the foundation phase, teachers code switch in grade 4 to explain words learners find it difficult to explain. According to Phiri (2014: 65) learners performed better in schools where code-switching was used, than in schools that did not employ it at all. In addition, Setati, Chitera and Essien (2009:72) attested that there was a high number of pass rate in schools where code-switching was used. Code-switching does not necessarily mean that teachers teach in learners' home language in the Intermediate Phase, it only means they are explaining words, which learners find difficult to comprehend in a text. The usage of manipulatives and concrete objects in a mathematics classroom enhances problem-solving skills for grade 4 learners in word sums. Teachers may sometimes allow able learners to dramatize mathematical concepts that other learners find difficult to comprehend. Such concepts could be division or multiplication where learners could be asked to bring along flowers of different or same colours in a mathematics classroom. This would be done with an aim of stimulating interest in learning word sums. `

In conclusion, through dramatization, grade 4 learners'mathematical problem-solving skills in word sums are enhanced, because learners do not forget what they learn

through play (Mokotjo, 2017:164). The next section discusses the problem statement of the study.

1.2. RESEARCH PROBLEM

The National Curriculum Statement (DBE, 2012:5) aims at producing learners that will be able to identify and solve problems critically and creatively, and to make informed decisions in recognising that problem-solving contexts do not exist in isolation. The curriculum has been designed in a manner that will equip learners with knowledge, skills and values that they will be able to use in their lived world. In the study of mathematics, learners in the lower grades often struggle to comprehend and solve mathematical word sums (Du Toit, Fronean & Maree, 2002:54). According to Conley (2013:2), mathematics teachers came to the realisation that word sums are difficult for all learners to understand, especially the grade 4's who have been taught mathematics in their mother tongue in the previous grade. These learners battle in making meaning of the text, and fail to decide on the operation that best suits the problem to be solved. Grade 4 learners tend to use whatever operation that comes to mind without understanding the text. If the problem requires learners to add, they put the inverse operation to use. For example, if 17 are boys and 12 are girls in a grade 4 class, how many learners are in a grade 4 class altogether? Some learners use addition signs, 17+12=29 while others use a subtraction sign 17−12=05. Learners that put a subtraction sign clearly did not make meaning of the text and what operation was required to solve the problem. The same thing applies with multiplication and division, for example. If there are 5 desks in one row, how many desks will be in 10 rows? Some learners will do the sum as follows: 10÷5= 2, instead of 5×10=50 and this then affects their entire performance in the subject. It is for this reason that the strategy has been designed to enhance problem-solving skills for grade 4 for learners in solving word sums.

1.3. RESEARCH QUESTIONS

The primary research question for the study reads as follows:

How can we enhance grade 4 learners' Mathematical problem-solving skills in word sums?

The secondary research questions are as follows:

- What is the challenge pertaining to the teaching and learning of word sums in a grade 4 mathematics classroom?
- What are the solutions towards the teaching and learning of word sums in a grade 4 mathematics classroom?
- Under which conditions will the implementation of the strategy in the teaching and learning of word sums be successful?
- What anticipated threats can be identified and how to circumvent them when the strategy towards the teaching and learning of word sums is being implemented?
- What indicators can be identified towards the successful implementation of the strategy in the teaching and learning of word sums in a grade 4 classroom.

1.4. RESEARCH AIM AND OBJECTIVES

The aim of the study is to enhance grade 4 learners' Mathematical problem-solving skills in word sums.

Objectives of the study are as follows:

- To identif the challenges facing grade 4 learners' in solving word sums.
- To analyse the strategy that will be used to improve grade 4 learners' problem-solving skills in word sums.
- To identify the conditions under the strategy to improve grade 4 learners' problem-solving skills in word sums.
- To circumvent the threats identified, that may hinder the successful implementation of the strategy to improve grade 4 learners' problem-solving skills in word sums.
- To identify the indicators for evaluating the success of the strategy that has been used to improve grade 4 learners' problem-solving skills in word sums.

1.5. RESEARCH DESIGN AND METHODOLOGY

The research design is a detailed plan the co-researchers followed when empirical data were generated in a number of planned activities (Van Wyk, 2012:2). The research design stipulated the tools to be used when data were generated and the methods on how the data responded to the research question mentioned above. The co-researchers identified the challenges encountered in a mathematics classroom during teaching and learning of word sums, using different approaches and methods.

The study employed Participatory Action Research (PAR) as research methodology to examine whether the strategy was successfully implemented in enhancing problem-solving skills for grade 4 learners in word sums. According to Kemmis and McTaggart (2005:568), PAR emancipates voiceless members of the society and shapes them into becoming better and fully accepted citizens. In addition, MacDonald (2012:37) views PAR as a pragmatic intervention that will succeed in giving the voice to the target group. Denzin and Lincoln (2008:277) refer to PAR as a social process of collaborative learning, actualised by a group of people changing lives of another group of people to realise the intended goal. Furthermore, PAR is thought to involve a number of stages on implementation, namely: planning, action, observation and lastly reflection in a spiral manner (Kemmis & McTaggart, 2007:1). However, PAR uses a wide range of qualitative approaches that allow people to interact in a shared social world. Co-researchers planned and presented lessons on word sums in different topics and met during reflection sessions to discuss challenges encountered during the action stage. The way forward was also communicated during the reflection stage and re-planning was done by the co-researchers for re-enforcement. Since PAR is participatory, all members of the team had equal power and the right to make constructive opinions (Baum, MacDougall & Smith, 2006:854) towards changing the lives of the grade 4 learners, when their problem-solving skills in word sums were enhanced.

1.6. THEORETICAL FRAMEWORK OF THE STUDY

This section discussed Bricolage model as a lens which was best suitable for the study to enhance mathematics for grade 4 learners' problem-solving skills in word sums. According to Kincheloe (in Lincoln, 2001:693), bricolage is a handyman or woman who makes use of any material available to complete a task. On the other hand, Aagard

(2009:28) views bricolage as a person who creates something out of whatever is available around their environment to make a new meaning. Bricolage, and its multiplicity, multiple perspectives and multiple theories, was used by the co-researchers in enhancing grade 4 learners' problem-solving skills in word sums. Bricolage is well explained through the eight historical moments (Denzin & Lincoln, 2008:27), which are named the traditional period, modernist phase, blurred genres, crisis of representation, postmodernism, post experimental, the seventh moment and the fractured futures. A detailed discussion of the historical moments of bricolage were dealt with in reviewed literature in chapter two of the study.

Formats of bricolage, comprise of: theoretical bricoleur, narrative bricoleur, political bricoleur, methodological bricoleur and interpretive bricoleur. These formats were discussed in detail in literature review. Bricolage is a theoretical framework that opposes the positivistic ontology that is embedded in one single truth (Kincheloe, 2004:4). Its interpretations of life experiences are multi-dimensional, where multiple perspectives, multiple approaches and methods are used to give the voice to the marginalised. In bricolage, the nature of reality is interrelated to pluralism (Baloyi-Mothibeli, 2018:25) where the members of the team share ideas with an aim of enhancing grade 4 learners' problem-solving skills in word sums. Epistemology, which is the philosophical theory of knowledge construction (Kincheloe, 2004:6) through teamwork, will also be discussed in chapter two of the study. The objectives of bricolage, the role of the researcher and their relationship with the participants and how appropriate bricolage is to the study, are discussed in the next chapter (Kincheloe, 2005:2). The role of the researcher, which is that of co-ordinating the study will be elaborated on and the kind of relationship she/he has with the research team, as well as the kind of language they speak when addressing one another (MacDougal, 2011:289). The appropriateness of bricolage was evident when the objectives of the study were achieved by the research team in a number of planned activities where grade 4 learners were actively involved in the enhancement of their problem-solving skills in word sums.

1.7. DATA GENERATION

For this study, Participatory Action Research (PAR), an approach to qualitative research, was used to generate data. Mkumbo (2012:149) describes a qualitative research as one that is used to determine and understand people's experiences, beliefs, attitudes and conduct. According to MacDonald (2012:9), different approaches of data generation were in line with PAR and were agreed upon by the research team. Research was done in one of the rural schools in the outskirts of Dannhauser. The school has very little resources and learners walk long distances from families that are faced with poverty and unemployment. Data were generated through meetings, discussions, workshops and daily observations. Minutes were taken for every meeting held. Generated data were recorded using tape recorders and video recorders and were analysed during the reflection meeting.

The research team got together for brainstorming and conducted a SWOT analysis. They identified the strong points, weaknesses, opportunities and the threats that might impede the progress of the study. A qualitative research was best suited for this study for the reason that it permitted the research team to best describe and utilise their experiences and abilities in enhancing mathematics for grade 4 learners' problem-solving skills in word sums. In the attempt of realising the intended goal, both PAR as an approach to research, together with Bricolage as a theoretical framework, were utilised by the research team.

1.8. SELECTION OF CO-RESEARCHERS

The co-researchers comprised of the researcher, the person whom the study belongs to, which is the researcher, three mathematics teachers for grades 5, 6 and 7, as well as two heads of departments, for intermediate and senior phases. The principal and his deputy and two School Governing Body (SGB) members representing the parent component and 40 grade 4 learners, were also involved. The principal and the deputy principal were requested to give moral support and to give the study validity and dignity so that everybody could take it as serious. The parent body volunteered to be part of the study. They felt it would be a great experience for them to be part of their children's learning experience. Mathematics teachers were requested to participate in the study, because they have the Pedagogical Content Knowledge and Mathematics

Knowledge, which is core to the study, and they would be the ones who would be directing the ship in preparing and presenting activities towards the enhancing of grade 4 learners' problem-solving skills in word sums. Chandler (2010:1) re-iterated that participants are not just subjects in the study, but they are active members who engage fully and without fear (Blake, 2007:412) in all stages of the research process. With the knowledge they acquired and with the methods and theories of the qualitative research, they succeeded in achieving the objectives of the study.

1.9. DATA ANALYSIS

Critical Discourse Analysis (CDA) was used to analyse generated data. According to Van Dijk (1993:251), CDA is a tool used to analyse and interpret uttered words by co-researchers during data generation. The analysis and interpretation of data focused on interpreting information recorded during meetings and discussions. Bloor and Bloor (2007:2) attest that CDA is a paradigm that analyses the given text across all the fields of the lived world, whereas Van Dyk (1994:353) sees it as a type of analytical research that ensures that social power, abuse, dominance and inequality are not exercised politically and socially. The research team presented and interpreted their argument from different angles and their opinions were taken into consideration. CDA was relevant to the study, because it talked directly to the problem, where mathematics teachers emancipated one another through pre-planned activities until the problem-solving skills for grade 4 learners were enhanced. The objectives of the study were achieved and that was evident when learners' performance in solving word sums improved.

1.10. VALUE OF THE PROPOSED RESEARCH

The study sought to enhance problem-solving skills for grade 4 learners in word sums. Research was about identifying the challenges teachers and learners encounter in a mathematics classroom during the teaching and learning of word sums. Findings revealed that teachers' misconceptions also contributed to learners' shortfall in conceptualising word sums. However, the study benefitted teachers in ensuring that the word sums were well planned for and presented in a manner that benefits learners.

The school also benefitted from the study, because learner performance in word sums and in the whole of mathematics for grade 4 learners improved to a higher degree .Not only grade 4 learners benefitted from the study, but also learners in the grades 5, 6 and 7, because mathematics teachers for the aforementioned grades were part of the research team and that on its own restored the schools' reputation. The study will benefit citizens of the country who will pursue studying further. The subject advisors benefited even though they were not participating in the study. The study can be used as a tool for advising mathematics teachers on how to go about addressing the challenges in the teaching and learning of word sums. Parents benefitted also from the study by gaining insight on how to assist learners with homework.

1.11. ETHICAL CONSIDERATION.

Permission to conduct the study was sought from the KZN Department of Education (Appendix B). As a student and registered with the University of the Free State, the researcher sought permission to generate data from the Ethics team (Appendix A). The School Governing Body and the school principal offered permission to conduct the study, because learners and teachers would be the co-researchers in the study. Permission for participating learners was sought from their parents and consent letters were issued out for parents' approval. Pseudo names, were used to maintain confidentiality of participants in this study. Other co-researchers also signed the consent letters and the anonymity clause was disclosed to all participating members. The researcher was responsible for the ethical quality of the study (Henning, Van Rensburg & Smit, 2004:213). Everyone was informed that their participating in the study would not be remunerated and that they had a choice and free will to leave the study when they felt they were no longer interested in partaking. All the co-researchers were regarded as equals to the study; therefore, the language of respect was instilled at all levels.

1.12. LAYOUT OF CHAPTERS

The following is an outline of this study:

Chapter 1: This chapter discusses an overview of the whole study.

Chapter 2: This study focuses on the theoretical framework and literature review.

Chapter 3: This chapter discusses the research methods and the design utilised in order to enhance grade 4 learners' mathematical problem-solving in word sums.

Chapter 4: This chapter focuses on the analysis, interpretation and findings of the study.

Chapter 5: The chapter presents a summary and limitations of the study, recommendations and suggestions for future research.

1.13. CHAPTER SUMMARY

This chapter discussed the introduction to the study, challenges encountered in mathematics classrooms during the teaching and learning of word sums, and solutions pertaining to the strategy to enhance grade 4 learners' problem-solving skills in word sums. Conditions towards the successful implementation of the strategy, hindrances that might impede the successful implementation of the strategy and how to circumvent them were discussed, as well as evidence of the successful implementation of the strategy. A research problem, research question, theoretical framework, bricolage, that guided the study, its formats, ontology and epistemology were discussed. The research aim and objectives were outlined and presented. The methodology and the methods that were used to analyse the generated data and research site profile were discussed. The last pages of the chapter discussed the value of the research and the ethical consideration. Chapter 2 discussed a theoretical framework as lens to the study and literature review towards enhancing grade 4 learners' mathematical problem-solving skills in word sums.

CHAPTER 2 :
THEORETICAL FRAMEWORK

2.1 INTRODUCTION

The aim of the study is to enhance grade 4 learners'mathematical problem-solving skills in word sums. The main purpose of this chapter is to present a theoretical framework, which outlines the structure of the research. The chapter will begin with a discussion of bricolage as a theoretical framework, its originality and formats as a way of responding to the research question, as well as the aim and objectives of the study. The chapter continues to discuss the role of the researcher, epistemology, ontology and the relationship between the researcher and co-researchers. Operational concepts used are clarified and lastly, the literature review that responds to the objectives of the study, is presented.

2.2 THE ORIGIN OF BRICOLAGE AS A THEORETICAL FRAMEWORK

The theoretical framework used in this study as a lens is Bricolage. Bricolage originates from a French word "bricoleur", which describes a handyman or woman who makes usable tools available to fulfil a task (Levi-Strauss, 1966:1). In addition, Aagard (2009:82) sees a bricoleur as someone who creates something out of what is available around their environment. In the mathematics environment, the researcher used every resource available to instil conceptual understanding of word sums (Blöte, Klein & Beishuizen, 2000:227). Conceptual understanding means incorporation of ideas into meaning making (Bartell, Webel, Bowen & Dyson, 2013:57). According to Seale, Gibson, Haynes, and Potter (2015:536) this will be possible when the researcher, together with the co-researchers, use whatever resources are available in the classroom during teaching and learning to enhance learners' understanding of word sums. Berry (2015:78) conceptualised bricolage and it was investigated further by (Kincheloe, 2004:73) and (Rogers, 2012:2) in educational inquiry using multiple frameworks and multi methodologies to empower researchers to gain deeper meaning through life experiences and educational phenomena (Berry, 2015:80). Using bricolage assisted the researcher to apply differentiation in the teaching and learning

of word sums to address diversity in a mathematics classroom, because differentiation is the strategy used by teachers to accommodate all learner types in the classroom (Mertens, 2014:1).

In addition, Rönkkö, Peltonen and Arenius, (2013:45) view bricolage as an option that produces resources at hand with an aim of creating new usable resources. Rönkkö *et al.*'s (2013) perception of bricolage assisted the researcher in collaboration with co-researchers to utilise resources at their disposal to enhance grade 4 learners' problem-solving skills in word sums. It is for this reason that the researcher and the co-researchers devised a strategy to enhance grade 4 learners' problem-solving skills in word sums. This was possible when the multiplicity of bricolage was implemented at all cost (Kincheloe, 2011:2) to realise the intended goal. Bricolage was discussed through the eight historical moments, which are the traditional period, the modernist phase, blurred genres, crisis of representation, the postmodern moment, the post experimental moment, the seventh moment and fractured futures (Riley & Love, 2000:164). The historical moments, as underpinned by Bricolage and how each one of them was appropriate for the study, were discussed.

2.2.1 First moment: The traditional period

This period began during the year 1900 and ended in 1950 (Culver, Gilbert & Trudel, 2003:13). During this period, colonisation of field experiences by qualitative researchers reflected a positivist scientific paradigm (Antwi & Hamza, 2015:218). This means that their main focus was to extend valid and reliable interpretations in their writings, focusing on broadening valid, objective and reliable interpretations in their writings. During this period, policies that were developed were objective and were believed never to change (Riley & Love, 2000:65). The traditional period assisted the researcher in unpacking the rules and procedures in the teaching and learning of word sums where learners were made aware of understanding the text first before attempting to solve the problem (Hill *et al.,* 2008:372; Kincheloe, 2011:333). For instance, in a primary school 7-9 is considered undefined, because we cannot take away a bigger number from a smaller number, though it is correct mathematically in the advanced grades. The correct and accepted way of writing it in the Intermediate phase is 9-7= 2. Therefore, telling learners during teaching and learning of word sums

is acceptable to clarify challenging concepts with an aim of enhancing learners' problem-solving skills. There was no better way of explaining this concept than just telling it like it is. Similarly, this moment was corroborated by Mhlolo (2014:1585) when he said that what the teachers teach to learners as they were the only source of information, was regarded valid and reliable and not to be contended.

Moreover, the methods from the traditional moment can still be used to develop counting skills to grade 4 learners in understanding the multiples of numbers, which on their level is in line with the times table. Knowing the times table prepares them for the learning of multiplication and division of numbers, because teaching becomes easier when learners count in a mathematics classroom. Furthermore, explaining keywords, such as altogether, is left, more, less, sum, difference, product is imperative in a grade 4 mathematics classroom, because of a different meaning in mathematics and in a language, for instance. The word difference in language means something else, but in mathematics it refers to the answer we get when we subtract numbers. In the example: find the difference between 12 and 10, grade 4 learners will be able to say 2. The teacher will ask learners to write the sum on the given text to check whether they had been listening. If they get it correct then it is fine and if not, she will scaffold their learning using whatever material available to make meaning of the text e.g. diagrams before writing the sum 12-10=? The same thing applies with the word product**.** In mathematics, the product is the answer for multiplication, but it has different meanings when used in different contexts, e.g. dairy products are cheese, milk, butter, etc. These words make it difficult for grade 4 learners to understand the text and to choose the appropriate sign to the problem. However, the bricoleur has to just tell learners what these words mean in a mathematical perspective for a deeper understanding and for choosing a suitable operation for the problem to be solved (Peltenburg, van den Heuvel-Panhuizen & Robitzsch, 2012:351).

Apparently, telling learners what they need to do for better understanding of word sums is not good enough. Teachers also need to interpret the text in simpler terms (Peltenburg *et al.,* 2012) to make learners understand the same words used in different contexts. Understanding the text means that learners will be able to solve the problem posed.

This study sought to redress the injustices learners experienced during the positivism period where they were deprived of active learning, instead they were expected to just listen while the teacher is dominating the learning environment. However, the multiplicity of bricolage in this moment is useful in the study in the manner that rules and procedures will be followed. For example, in a mathematical sentence, the left-hand side equals to the right-hand side (LHS= RHS) (Pretorius, Potgieter & Ladeweg, 2012:16). Learners should be able to solve the problem posed, using the above–mentioned rule for learners to understand the keywords (Mhlolo, 2014:1585) that will assist them in solving word sums. Considering the type of teaching and learning underlined by the outcomes-based education paradigm, to some extent this moment was not beneficial to all learner types, because it has neither meaningful learning (Safdar, 2013:62) nor conceptual understanding, and it also does not allow learners opportunities to explore their potential, because it promotes rote learning. The traditional period does not cater for diversity in the learning environment, as it was also associated with reductionism where people were perceived as subjects in qualitative research (Given, 2008:8). It is for these reasons that the traditional moment did not last and opened doors for the second moment called the modernist phase.

2.2.2 Second-moment: modernist phase

This historical moment began in 1945 and ended in the year 1970. This moment was introduced to improve on the workings of the traditional moment, seeking to strengthen qualitative methods (Kincheloe, 2011:3). During the modernist phase the researchers resorted to new methods that suppressed the dominance of teachers, but that promoted active learning in a mathematics classroom (Mahlomaholo, 2014:174). The interpretive paradigm has an assumption that human beings build and fuse their own subjective meanings as they interact with the world around them (Okeke & Van Wyk, 2015:40). This moment motivates teachers to link learners' prior knowledge with the new knowledge for better understanding of word sums. For instance, letting learners tell their peers how many female and male people there are at home and what total number of people they have in each family. Each learner will be able to say: "I stay with 2 cousins, 2 aunts, 2 parents, 2 grandparents and 1 uncle, in total we are 10". In doing so, the teacher will be trying to use the rule of moving from the known to the

unknown, counting skills and classification of things before moving to the complex in the mathematics classroom.

It is this moment that recognises the existence of those who are marginalised in the main stream society, giving a voice to the voiceless. New theories came to being and every participating member in the inquiry was valued and made equal to the researcher (Nind, 2014:525). This moment enables the researcher to take into consideration the fact that all co-researchers in the study have equal value, no one is above the other and that their ideas, opinions and real life experiences are considered in emancipating the underprivileged (Baloyi-Mothibeli, 2018:16), which will be useful in the teaching and learning of word sums, using the multiplicity of bricolage. This moment, however, does not address all the challenges learners face in the learning of word sums, as it will consume a lot of time in doing so. It is time consuming in a sense that teachers will not be able to allow all learners in a class to bring their experiences one by one. The next discussion explored the third moment of bricolage, called blurred genres that amplified the previous moments of bricolage. It also assisted to better the teaching of word sums.

2.2.3 Third moment: blurred genres

The third moment of bricolage began in 1970 and lasted until 1986 (Milliken, 2001:71). Qualitative researchers during this period had an utmost recommendation of paradigms, strategies and approaches to use in their enquiry. Tobin (2018:113) attests that it was in this moment that the opinion of social realism and objectivist knowledge were challenged. Furthermore, many qualitative researchers comprehended the position that knowledge-making is basically an act of interpretation. Qualitative research during this period created disturbances to the researchers. They differed on the meaning of reliability and validity in an inquiry (Sandelowski, 1995:206). They were not sure what methods and approaches to use, in order to make meaning of the data they had generated. It was in this moment that the multiple theories, multiple perspectives, and multiple methods of bricolage were put into practice (Kincheloe, 2011:4) for deeper insight to the text.

Moreover, characterisation of pluralism and interpretive theories in this historical moment enabled the researcher to work collaboratively with other co-researchers. This

was done with an aim of promoting team-teaching in the teaching of word sums, because sharing of ideas (Di Domenico, Haugh & Tracey, 2010:689) equips learners with knowledge and skills they need for problem-solving. When genres begin to blur, it calls for more than one person and more than one method to get things on the right track. However, a collective effort in changing peoples' lives has more positive results than an individual effort.

Team- teaching will therefore be appropriate and best utilised in addressing the issues of blurred genres in this moment. Use of pictures, diagrams and concrete objects (Ryken, 2009:347) in a mathematics classroom assisted the researcher and the co-researchers in enhancing problem-solving skills for grade 4 learners in word sums, because pictures and diagrams will assist grade 4 learners in the interpretation of the text and making meaning of it, especially to learners that take too long to compute numbers (Fuchs, Fuchs, Compton, Powell, Seethaler, Capizzi, Schatschneider & Fletcher, 2006:29). Counters and other concrete objects like sweets, bottle tops, match sticks and buttons should be used in mathematics settings, in order to enhance grade 4 learners' problem-solving skills. For example, 16 sweets are to be shared by 4 learners. How many sweets does one child get? In this example 4 learners were brought in front of the class and each learner took one sweet at a time until all sweets were taken by learners. The class was asked to tell how many sweets each learner had. Using real objects will make things easier for grade 4 learners in solving this problem. However, as learners in class have different learning styles, this moment could not benefit all learners, the reason being, some will perceive concrete objects as toys with which to play (Rosli, Capraro, Goldsby, y Gonzalez, Onwuegbuzie & Capraro, 2015:1723), instead of concentrating on solving the problem posed and to master the concept. The next section addressed the fourth moment called crisis of representation.

2.2.4 Fourth moment: crisis of representation

This moment of bricolage began in 1986 up until 1990 when qualitative researchers attempted new models of truth, method and representation (Riley & Love, 2000:167), erasing anthropological norms of social life, which was structured by fixed rituals and customs (Given, 2008:709). The rationale of positivism on objectivity, validity and

reliability, which have been dealt with during the traditional moment resurfaced during this moment (Baloyi-Mothibeli, 2018:17) and critical theory, as well as feminist theory competed for attention, while interpretive theories were more preferable to writers in contending outdated models of truth and meaning (Holt, 2003:9).

According to Tobin (2018:114), this moment focuses on challenging the chances of creating the realities of lived experiences in the social context studied. Tobin further mentions that researchers progressively were interested in the political demand of text. It was portrayed as a device for establishing and sustaining specific relations of power that gave the voice to some, and also to the development of diverse capabilities, including creativity and cooperation, which could support future changes in the society (Mokotjo 2017:55), and that teachers played small roles, facilitating learning, then just merely teaching learners. For instance, learners were asked to bring along beads of different colours to the classroom with an aim of developing learners' creativity and counting skills. The teacher asked learners what beadwork could be made out of the beads they brought into the classroom. Different answers came from learners: bracelet, necklace, earrings**,** belts, etc. Learners were asked to make beadwork of their own choice. In addition, learners were asked to count how many beads in different colours they used to make the pieces of beadwork, and the total number of beads used altogether. They were asked how many more or less beads they used, comparing one colour with the next.

Furthermore, bricolage perceives research methods more actively than passively (Kincheloe, 2004:9), supported by Wickens (2011:151) in using available tools at hand that allowed the researcher to create an environment where peer-tutoring and group work are introduced, permitting capable learners to assist less capable ones (Rosco & Chi, 2007:535) in enhancing their problem-solving skills during the learning of word sums. Learners learn better when they interact with their peers, discussing ideas (Celik, 2016:111) in a language they understand better, than when they are taught by teachers, because active learning in a mathematics classroom is more effective than passive learning (Kincheloe, 2004:9). This moment had its limitations in that more capable learners ended dominating the discussions and less capable ones remained passive during discussions, as they contributed nothing to fit in the group. Less capable learners could not ask questions even when they did not understand the concept; they remain passive until the end of the activity. They just take whatever they

are told without any understanding and that does not enhance their problem-solving skills. Co-researchers also experienced difficulties in interpreting themselves in reflexive texts and this paved way to the fifth moment of bricolage.

2.2.5 Fifth moment: postmodern period

The fifth moment of bricolage known as the postmodern period began from the period 1990 up until 1995 (Le Grange, 2018:3). During this period ethnographers battled to make meaning of the crises that emerged during the fourth moment of qualitative research (Lewis, 2009:27). The postmodernists directly dispute the modernists' research aim of attaining general, explanatory and predictive structures within its own perception of knowledge, as basically unstable. They further concur with postmodern writers on the idea that research is a political activity (Lawton, McGuire & Rajwani, 2013:86) with a variety of social organisations where racial, religious, ethnic, and cultural groups were tolerated as central themes in their writings. For this moment collaboration and cooperative learning are promoted amongst participants (Nunan, Swan & David, 1992:19). This was done in order to make sense of the crises that arose during the fourth moment as the experiences of the researched community were misrepresented.

This moment emerged to amend the hiccups that were identified in the fourth moment. It enabled the researcher to encourage grade 4 learners to interact with one another during the learning of word sums and to construct their knowledge through learner-centred approaches (Schweisfurth, 2011:425). Learners were told to bring along different types of counters to use in a mathematics setting. These counters come in different shapes and colours. They were told to sort those counters according to their similarities e.g. number and types of sides, colours and count them. Their problem-solving skills were enhanced through cooperative learning in learner-centred approaches. Their prior knowledge was linked with the new knowledge through story-telling, say- and - do approaches, which are approaches many learners enjoy during their learning. Learner-centred approaches work the best in this moment for the reason that their emphasis is on active learner participation, minimising dominance of the teachers in mathematics settings. This moment promotes the multiplicity of bricolage (Wickens, 2011:151), in perspectives, theories and methods where any material

available is used through the guidance of the teachers to enhance grade 4 learners' problem-solving skills in word sums. Too much learner dominance in this moment can be offending to less capable learners in a manner that can prevent them from participating fully in classroom interactions. This moment motivated the researcher to discuss the sixth moment of bricolage.

2.2.6 Sixth moment: post experimental

Post experimental is the sixth moment of bricolage which began in 1995 and lasted till the year 2000. During this period fabricated ethnographers and multimedia texts were not acknowledged (Berry, 2015:77). Researchers during this period sought to merge what they had written about in their enquiries with what the liberated citizens need to conform to without fear of victimisation by immoral writers who did not subscribe to components of qualitative research, democracy and social justice (Ravitch & Carl, 2016:10). According to Locke (2003:36), this moment brought a lot of change and disturbance to new researchers as they engaged themselves into the interpretive paradigms, which in their experimental forms of writing, blurred the limits between social sciences and humanities. Riley and Love (2000:169) assert that ethnographers used approaches that involved lived experiences, like novels, poetry, visual and drama, because learning is experimental. This argument can be demonstrated by the following scenario. Two cakes are cut at a birthday party. One is cut into eights and the other into quarters. Bongani's sister asks him to choose which one he likes. Bongani chooses the bigger piece over the smaller one. Using the above scenario, the teacher asked learners why they thought Bongani did not choose the smaller piece of cake. The answer was that he preferred a bigger piece to a smaller one. The teacher concluded by saying the piece Bongani chose is called one quarter and the other one is one eighth. Therefore, a quarter is bigger than an eighth. This activity addressed equivalent fractions in word sums and learners had a better understanding about the equivalent fractions.

Experimental learning is one kind of approach teachers can use to make meaning of the text in word sums. Real life experiences used in a number of methods (Rogers, 2012:5) will assist in the realisation of the objectives of the study to improve grade 4 learner's problem -solving skills in word sums. Even though this moment has good

practices, its shortcomings are that not all learners can benefit from experimental learning for a number of reasons. Amongst many is that by not having anything to bring into class because of socio economic backgrounds, can be associated with lack of taking responsibility. Other real-life experiences can affect learners directly or indirectly and can be destructive or constructive to learning. This was apparent when some learners did not focus on what the teacher was saying using a birthday cake. Instead of being inspired to learn fractions in word sums, learners were eager to consume the cake. The next section discusses the seventh moment of bricolage.

2.2.7 Seventh moment: present time

The seventh moment of bricolage called the Present time started in the year 2000 (Annells, 1996:380). The critical researcher encourages the seeking of new standards and new tools for evaluation. Furthermore, this moment surfaced to redress the imbalances of the traditional period on validity and reliability, ensuring that the study is conducted within the paradigms of ethics and that the information contained is reliable for usage. This meant that policies that have been put to place should be administered during teaching and learning (DBE, 2012:3). In this moment teachers use innovative modes of expressions through story-telling, poetry, drama and other modes to assist learners find their stance in the society (De Beer, 2003:5): In using a story-telling approach, learners are equipped with listening skills, which take precedence of all other skills in a learning environment. This was strengthened in the following exercise: 10 goats were released early in the morning to graze in the veld. 3 more goats returned home with them at sunset. How many goats came back home that day? Grade 4 learners were told to write a number sentence to the above sum. With the aid of the keyword ‘more’, they were able to write it as: 10 + 3 = 13.

In addition to the above exercise, learners were asked to dramatize a scenario where 5 eagles were invading the mielie field. One of them notified of the owner of the field who suddenly emerged with a gun. The second eagle requested that they should fly and leave the field. The third one said they were not afraid of the gun. Before they knew it, the gun went Bang! One eagle was shot and the rest flew away. How many of the eagles escaped the gun? Again, learners were able to say: 5 – 1 =4

However, this moment enabled the researcher and mathematics teachers to use the rhymes, and dramatization in preparing learners towards problem-solving in word sums, by using the multiplicity of bricolage (Rogers, 2009:12) It also gives platform to learners to interact with their peers as they learn through play, which is the most effective way of their learning, because what learners do as they play, they do not forget easily. Mental activities in a mathematics class arouse learners' interests in the subject, which many people believed it was difficult. Using of multi genres (Kincheloe, 2011:2) in a maths class encourages a positive attitude towards the subject and promotes oneness, because learning is participatory (Pain, Whitman & Milledge, 2011:37). This moment, however, did not work for all learners, because it does not address the issue of differentiation in a mathematics setting. According to Westwood (2001:5), differentiation is the mathematical process teachers develop in terms of content, resources and assessment with an aim of making teaching conducive to all learners, because learners learn at different paces. However, teachers have to plan ahead in order to cater for such learners in mathematics classrooms for the teaching of word sums to be effective (Bondy, 2011:8). Limitation to this moment is that not all learners benefit from it for the reason that not all of them get to participate in planned activities, due to time constrains. This moment propelled the researcher to discuss the eighth moment of bricolage.

2.2.8 Eighth moment: fractured futures

Fractured futures, the eighth moment of bricolage, started in 2004. This was a period where researchers encountered difficulties in their writings. This meant that the use of a single method in making meaning towards the writing was not working for researchers anymore (Flick, 2014:19). This therefore called for an intervention of applying a wide range of methods and approaches to make meaning of a complex and diverse social world. Drawing from Denzin and Lincoln's work, Onwuegbuzie, Leech and Collins (2010:697) attest that there are recurring methodological arguments among many disciplinary communities of qualitative research in the seventh and eighth moments. The usage of a single moment in this regard meant that the researchers did not rely on one method for their writings to be meaningful. They believed that the inclusion of a variety of methods would give a deeper understanding

of text in this ever-changing world. However, fractured futures is the period where the multiplicity of bricolage is used to the extreme, where the new methods and those that were used during the traditional period are used interchangeably (Bland & Altman, 2010:931) in order to enhance learners' problem-solving skills to higher heights.

This moment allows the researcher and the co-researchers to use a variety of methods, theories and perspectives to fill in the gaps that were identified in (cf. 1.1) in grade 4 learners' performance in word sums that enhanced their problem-solving skills. Such gaps result grade 4 learners to experience difficulties in solving word sums, as they fail to apply a suitable basic operation in making meaning to the given text. Their main challenge is that they are being taught mathematics in English in the grade they are in, whereas they were taught in vernacular from the previous grade. These activities are given to learners with an aim of finding out which learners understand better. To this present moment word sums are problematic for grade 4 learners to understand, and teachers are doing their utmost best to assist learners improve on their problem-solving skills. However, this moment enables the researcher in collaboration with co-researchers to use resources available, including indigenous games like *Morabaraba* (Nkopodi & Mosimege, 2009:29), which learners are familiar with and they engage in, in daily life experiences to enhance problem-solving skills for grade 4 learners. Making use of *Morabaraba* assists the researcher and the co-researchers in developing logic and critical thinking amongst grade 4 learners so that they are able to compute numbers and to solve word sums on their own. Nevertheless, introducing skipping during the teaching of words is one way of developing the counting skill during their learning. Counting up to 100 counts without failing makes one learner a winner. This stimulates young learners' attention and develops their confidence for the reason that they all wanted to become winners in the game. For instance, learners are given a task to sort different types of counters according to their shapes, namely, triangles, squares, rectangles and circles. Once learners were through sorting the counters, they were then given a task to record how many shapes they collected for each kind. The multiplicity of bricolage in this endeavour benefited learners when they were able to describe, sort and compare the shapes (DBE, 2012:59) and to be able to record the data. Limitation to this moment is that not all learners will get a chance to be hands-on, however, allowing all learners to take turns in doing this activity could consume a lot of time. Nonetheless, the multiplicity of

bricolage, which entails multiple approaches, multiple perspectives and multiple theories in this endeavour, benefitted learners when their problem-solving skills in solving word sums were enhanced, by using a number of planned activities to enhance different skills. The historical moments were discussed with an aim of assisting the co-researchers to justify the objectives of the study.

2.3 FORMATS OF BRICOLAGE

Bricoleurs are people who create something out of what is available around their environment (Aagard, 2009:82). They are well known for their creativity of combining theories, using a wide spectrum of perspectives and employing a number of methods to achieve an intended goal (Kincheloe, 2004:73). Formats of bricolage discussed are narrative, political, interpretive, theoretical, and methodological bricoleurs (Kincheloe, 2005:323). Furthermore, formats of bricolage are the constituents that describe how bricoleurs construct knowledge in different dimensions, in order to reach the end goal Bricoleurs are researchers who make use of any leftover material to make something valuable. The following are different bricoleurs who constructed knowledge in varied theories and methods to unfold and interpret abstract mathematical concepts for deeper understanding.

2.3.1 Theoretical Bricoleurs

Theoretical bricoleurs work on a number of interpretive theories, such as constructivism, feminism, cultural studies, Marxism, query theory, and many more that emerged during the third moment of qualitative research where the genres blurred (Ngulube, Mathipa & Gumbo, 2015:43; Rodgers, 2009:6) to unpack and interpret the mathematical concepts and texts for grade 4 learners in the learning of word sums (Rogers, 2009:6). For instance, a grade 4 class has 47 learners; 25 of the learners are girls. Find the number of boys in this class. Not all learners were able to get a correct answer. Some said 47+25=72, while others said 47-25=22. A theoretical bricoleur then changed the direction of the ship by saying, remove a smaller number from a bigger number and tell me what you get. Leaners then wrote 47-25=22. The bricoleur then asked learners how many boys were in a grade 4 class. Furthermore, theoretical

bricoleurs know exactly when to divert to other theories when they feel one theory has not fulfilled the objectives of the study to enhance problem-solving skills for grade 4 learners. This bricoleur tells learners to add 25 and 22 and see what answer they come up with. She/he tells them that addition is an inverse operation for subtraction and vice versa. A theoretical bricoleur understands the different theoretical contexts in texts that can be interpreted and therefore provides an ideal theory to make meaningful text, based on depth, rigour and multiplicity (Honan, 2004:99; Kincheloe, 2005:323). Being a theoretical bricoleur will assist the researcher in working within and between varied theoretical frameworks in choosing appropriate tools, such as concrete objects, pictures and drawings that will enhance problem-solving skills for grade 4 learners. This bricoleur further asks learners to put 25 counters aside and 22 on the other end, then asks learners to count them all. A bricoleur tells them that the counters represent the number of boys and girls in a grade 4 class.

2.3.2 Narrative Bricoleurs

A narrative bricoleur value how knowledge on political theory is developed by understanding its influence on processes and texts (Rogers, 2012:7). This bricoleur depicts proficiency from a range of perspectives, voices and sources (references). Using a narrative approach will allow the researcher to employ various voices, which are mathematics teachers, to interpret knowledge from various sources in a number of pre-planned activities that will enhance the teaching and learning of word sums in grade 4 learners. Mathematics teachers, who are regarded as narrative bricoleurs will explain difficult words grade 4 learners find difficult to understand, using what is available to get the job done (Mambrol, 2016:9) to solve words sums. Such words are: altogether, left, difference and sum. In 25+22=47, 47 is the sum of 25 and 22. Furthermore, in 47-25=22, 22 is the difference between 47 and 25. A further explanation is that 22 and 25 altogether equals 47. This bricoleur asks learners that if there are 10 sweets on a plate and 5 of them are given to 5 learners. How many sweets are left? This bricoleur explains to learners that words ‘altogether’ and ‘sum’ are used in addition while ‘left’ and ‘difference’ are used in subtraction

2.3.3 Interpretive Bricoleurs

According to Rogers (2012:4) an interpretive bricoleur understands that research is an interactive process between the researcher and the co-researchers who participate in the study. These bricoleurs believe that knowledge and political interpretation are inseparable. This simply means that knowledge can be interpreted in multiple comprehensive perspectives (Kincheloe 2005:335). Being an interpretive bricoleur will enable the researcher to interpret the mathematical text in a range of perspectives, theories, materials, actions and experiences fitted together to the specifications of a complex situation (NCPEA, 2007:6) that will enhance problem-solving skills in word sums for grade 4 learners, taking into account the researcher and co-researchers' history, personal and social characteristics and how they impact the inquiry process (Finlay, 2002:532). Interpretive bricoleurs make sure that they interpret the text in a way that guides learners towards better understanding, in order to be able to solve word sums. In the example, 2 groups of 6 sweets equals how many sweets in total? This bricoleur told learners to count 6 sweets and make the first group and the other 6 a second group. She/he asked learners to count all the sweets. She/he told them that 2 groups of 6 sweets is also written as 6+6=? Which is addition or 6×2=? Which is multiplication? In this example learners were told that they can either add or multiply, in order to get to the answer.

2.3.4 Methodological Bricoleurs

According to Mambrol (2016:9) *in The Savage Mind,* Levi Strauss perceived the word 'bricolage' as the skill of using whatever is available to create something new and meaningful that will change people's lives for the better. A methodological bricoleur is so innovative and uses a wide range of methods (Rogers, 2012:5) in uncovering and pursuing the objectives of the enquiry of learners' shortcomings in solving mathematical word sums. These bricoleurs are not restricted in employing one single method in exploring their ideas throughout their entire study.

A methodological bricoleur is affirmed by Wickens (2011:151), in using multiple analytical methods and tools to conceptualise word sums. This bricoleur can use repeated addition for a multiplication sum, and division as an inverse operation for multiplication to show that these operations can be used interchangeably in enhancing

problem-solving skills in word sums This means that right from the very onset of data generation, researchers make use of classrooms observations, meetings, workshops and other approaches to make meaning of the study till the very end where critical discourse is analysed through generated data (Berry, 2004:38).

Various tools are used by bricklayers to establish a building, so do bricoleurs create something out of material available, by using multiple research methods to enhance problem-solving skills in word sums (Denzin & Lincoln, 2008:5; Aagard, 2009:82, Mahlomaholo, 2013:385). In being methodological, bricoleurs enable co-researchers to combine multiple methods, tools and techniques using PAR as approach methodology to enhance grade 4 learners' problem-solving skills in solving word sums. In this example, learners were asked to collect containers of different sizes and bring them to class with an aim of teaching volume and capacity. The containers come in sizes of 250ml, 340ml, 500ml, 1l, 2l, 3l, 5l and 20l.This bricoleur asked learners to use smaller containers to fill larger ones with water. Learners were asked: a) How many 250ml bottles of water fill a 500ml bottle? b) How many 500ml bottles of water fill 1l bottle? And c) How many 1l bottles fill 5l bottle, like, 250ml of water added to another? This was done until all containers were filled with water. Learners' responses were as follows 250ml+250ml=500ml of water, 500ml+500ml=1l. and 1l+1l+1l+1l+1l=5l of water. This was done in an attempt to include all basic operations in this activity with an aim of addressing the multiplicity a methodological bricoleur utilises to enhance problem-solving skills for grade 4 learners.

2.3.5 Political Bricoleurs

Denzin and Lincoln (2008, in Rogers, 2012:7) are of the idea that political bricoleurs understand that knowledge and power are intertwined. This simply means people need to be knowledgeable in order to be powerful. These bricoleurs also embrace the fact that science is power, for the reason that every scientific research is politically influential (Kincheloe, 2005:336). Therefore, political bricoleurs produce knowledge that benefits those who are voiceless and are vulnerable in the complexity of the lived world (Freathy, Doney, Freathy, Walshe & Teece, 2017:425). Being a political bricoleur enables the researcher to utilise Pedagogical Content Knowledge and Subject Content Knowledge an educator has, necessary to enhance problem-solving

skills for grade 4 learners, using an array of perspectives, multiple theories in a variety of methods and techniques that will benefit learners in solving word sums. This bricoleur brought a picture of an aeroplane with its tail decorated with the colours of the national flag. Learners were asked to identify all the shapes that were part of the decoration on the tail of an aeroplane. Learners' responses were as follows: quadrilaterals, triangles, circles, squares, rectangles, etc. They were asked to sort the shapes according to the number of sides the shapes had, and to colour in the shapes of the same properties in a similar colour.

2.4 ONTOLOGY OF BRICOLAGE

Ontology is the metaphysical study of the nature of being and existence (Denzin & Lincon,2000:12). Bricolage is a product of rigour and complexity (Kincheloe, 2004:4), which informs bricoleurs of what is available in the world around us. The journey between the laws and morals, and the nature of social, cultural, psychological and educational perception will enable them to bring change to people's lives, bearing in mind the victories of multiple versions of the world and how people relate to the world they live in (Rogers, 2012:7). Kincheloe (2004) further mentions that participants from a wide spectrum of class, race, gender, ethnic and religious groups, get into deliberations with humility, which is open to culturally and historically contexts that will nurture and expand learners' learning capabilities in shared praxis. Wibberley (2012:8) mentions that the nature of reality is socially produced when people interact, and the knowledge people have, shaped the way they perceive the world around us. Collaborating with one another in the study enabled the co-researchers to be the voice of the grade 4 learners to use the multiple analytical methods, tools and techniques to enhance their' problem-solving skills in word sums.

2.5 EPISTEMOLOGY OF BRICOLAGE

Epistemology refers to the study of knowledge taking cognisance of its methods, validity, reliability and theory around it (McNulty, 2013:525). Knowledge empowers the researchers and the researched (Malebese, 2016:34) and is acquired in a number of

methods, theories and perspectives to produce something new and meaningful out of the leftover material (Phillimore, Humphries, Klaas & Knecht, 2016:7).

Bricoleurs assert that empirical research is inscribed at every level by human beings. Such inscriptions and the complexities they produce are a reminder of multilogical processes in an act when knowledge is produced and rigorously analyses the nature of knowledge and its relationship to notions like the truth, belief and interpretive understanding of the subject (Mertens & Wilson, 2012:169). With the knowledge learners have acquired through the usage of the multiplicity of bricolage, learners will improve on their problem-solving skills, and be able to solve word sums without any challenges. In the given scenario: learners were asked to look at the times taken by boys to finish a 400m track event during athletics competition. Finishing times were as follows: Tom's=60 seconds, Ben's=55 seconds, Bonga's=53 seconds and Linda's= 57 seconds. Following questions were directed to the learners: a) Who ran the fastest? b) Who ran the slowest? C) How many seconds were between Tom's and Bonga's times? Learners' responses revealed that Tom ran the fastest and Bonga ran the slowest. Learners had the notion that Tom ran the fastest, because 60 is bigger than 53, which is the time that was taken by Bonga, however, Bonga took longer to finish the race. A bricoleur then gave feedback that the one who took long to finish the race is Tom, because the bigger the number is, denotes the slowest pace taken where time is concerned.

2.6 THE ROLE OF THE RESEARCHER

The researcher is the main character in a research whose role is to lead the entire team of co- researchers who are also participants in an enquiry and who also have roles to play for a study to be successful (Malebese, 2016:36). The researcher convenes all the activities to take place in the study with the assistance from the co-researchers. The researcher together with co-researchers, did planning carefully and systematically following timelines and schedules in designing a strategy to enhance learners' problem-solving skills in word sums. Okeke and Van Wyk (2015:2) assert that the researcher should be flexible when plans and procedures need to be changed to make things possible, using innovative ways to solve problems that might hinder the success of the study. Furthermore, the researcher should exercise fairness and

transparency at all times and report facts without fear of being bias. Campanella (2009:11) attests that the researcher should create and assert team spirit with co-researchers and to make informed decisions that will benefit the researched. As a researcher, my role is to build up harmonious relationships with co-researchers, ensuring that there is a climate of mutual respect, openness and a will to share ideas that will be useful in enhancing grade 4 learners' problem-solving skills in a mathematics classroom (Quirk, 2010:14). Nevertheless, a researcher's role was also to facilitate equitable consideration of participants' diverse viewpoints, like different ways of interpreting and solving word sums. For instance, statements like 'Five LESS a number', a 'number LESS five', and 'a number LESS than five' interpreted as the same and, or different to give (a) 5-×; (b)×-5; (c)×<5. Interpreting mathematical statements, using equations makes it easy for grade 4 learners to solve word sums. The researcher may contribute his or her expertise and can learn from the team during his or her observations of the process.

2.6.1 The relationship between researcher and the co-researchers

According to Okeke and Van Wyk (2015:14), research is a scientific way of investigating a problem, as well as employing human methods and humans to address the problem that is being researched. Humans in an enquiry are addressed as co-researchers, because the study cannot be successful without their inputs as they have roles to play for the objectives of the study to be realised. It is for this reason that they are equals with the researcher in the study (Boog, 2003:425). Since the study is about enhancing problem-solving skills for grade 4 learners, they are as important as all other co-researchers. It was therefore crucial for the researcher to create a collaborative and cooperative environment between the co-researchers, planning all activities to take place in realising the objectives of the study, because the success of the study does not rely solely on one person, but the team at large (Ledwith, 2007:599) This then called for the utmost respect on the part of the researcher, assuring co-researchers of confidentiality, honesty, compassion, humility, transparency and objectivity (McDougal, 2011:289) when the study is being conducted. This was made possible through team-teaching and cooperative learning activities where everybody played a role in the area of their expertise.

Co-researchers were informed of opting out any time they feel uncomfortable in continuing to be part of the study. The relationship between co-researchers is viewed through the theoretical lens of Ubuntu where Chilisa (2012:22) asserts that Ubuntu gives direction with regard to the roles and obligations to the research and advances the spirit of togetherness and well-being. The relationship of co-researchers is also seen through the lens of bricolage where the naivety of childhood is being created and shaped into responsible citizenship of the society (Malebese, 2016:36). The researcher and everyone else who participate in the study, have equal rights in decision-making processes, because no one is above the other. This view contradicts that one of the positivists during the traditional period of qualitative research where human beings were reduced to subjects who had no say, but to follow the instructions from the superiors (Higgs, 1995:10). Through bricolage, co-researchers are encouraged to actively engage in the study and be part of the solution, through planning together designing activities around the content areas in the CAPS document that will enhance grade 4 learners' problem-solving skills in word sums. Learners were asked to measure lengths of different objects in the classroom. These objects include, desks, tables, mini cupboards and boxes. Asking teachers to facilitate that activity was one approach used to strengthen sound relationships amongst the researcher and the co-researchers. Findings to this activity was written on the board for the whole class assessment.

2.7 APPROPRIATENESS OF BRICOLAGE

In this section a summary of the appropriateness of bricolage is discussed. Bricolage is an ideal theoretical framework to guide this study for the reason that it is grounded in the epistemology of complexity and that it uses a variety of theories, perspectives, tools, techniques and methods that will assist in unfolding learners' potentials (Kincheloe, 2005:2). Bricolage allowed the researcher and co-researchers to get a better understanding of a problem, because it was presented in a wide range of perspectives, using a variety of resources that assisted learners to have a deep understanding of the text (Anderson, 2008:55). This was made possible through team-teaching strategies and through cooperative and active learning that supported peer-tutoring and group discussions (Mokotjo, 2017:58) This is supported by the idea that

bricoleurs use whatever material is available to make meaning of the complexity of learners' life experiences (Berry, 2004:125). In the following example, learners were divided into 4 groups. The groups were to calculate the distance around the following objects: a table, desk, door and window. Each group was given a metre stick and had to choose a scribe to record its findings. Learners were told that the longer side of each object is a length and the shorter is a width. The outcomes were written as follows:

Perimeter of a table= 150cm+150cm+75cm+75cm=450cm

Perimeter of a desk= 100cm+100cm+50cm+50cm=300cm

Perimeter of a window= 70cm+70cm+70cm+70cm=280cm

To realise the objectives of the study, the Perimeter of the door = 210cm+210cm+90cm+90cm = 600cm. Learners were asked to arrange the answers from the biggest to the smallest = 600cm, 450cm, 300cm, 280cm. Learners in this activity were hands-on with little facilitation by the teachers.

However, bricolage values the participation of co-researchers and their contribution to the study in a way that does not make a researcher superior to them, but equals in the process of knowledge production.

Bricolage was appropriate in a sense that it actively engaged teachers into methods such as induction, deduction and team-teaching approaches and techniques that analysed (Rönkkö *et al.*, 2013:45) solutions that addressed the challenges facing grade 4 learners in solving word sums. Cooperative learning activities enabled learners to share their ideas and to deduce from their peers' responses. The appropriateness of bricolage was evident when the objectives of the research study were achieved by the researcher in a collaborative effort with the co-researchers, where no participating member was given more power over any other member in the study (Nuryatno, 2003:40). Participation of co-researchers in the study ensured that bricolage was the suitable lens for the study, because of its multiplicity in perspectives, theories and methods. However, clear communication lines, transparency, mutual trust and willingness to liberate the marginalised, in order to bring change (Freeman, 2007:476; Luke, 2012:5) to the researched, assisted the co-researchers in completing the tasks that were shared in implementing the strategy towards enhancing grade 4

learners' problem-solving skills in word sums. Tasks were not imposed, but were deliberated amongst co-researchers for the effectiveness of the strategy.

2.8 OPERATIONAL CONCEPTS

Operational concepts within the study are defined and discussed in this section. These concepts are enhancing problem-solving skills in mathematical word sums.

2.8.1 Enhancing problem-solving skills

According to Mayer and Wittrock (2006:287), problem-solving is "cognitive processing directed at achieving a goal when no solution method is obvious to the problem solver", whereas Conley (2013:5), regards problem-solving as mental processes taking place in learners' minds, enabling them to produce solutions with the guidance of mathematical rules and procedures, given to them during teaching and learning, because problem-solving strategies are of special significance in education (Mettas & Constantinou, 2008:81). In addition, Trends in International Mathematics and Science Study (2012:12), attests that problem-solving entails reasoning and analysing, argument construction and development of innovative strategies in mathematics classrooms. Enhancing problem-solving skills means that teachers use established tools and a variety of techniques to help learners improve their problem-solving skills. Enhancing grade 4 learners' problem-solving skills in word sums means that teachers will not establish tools and techniques only, but multiple perspectives, theories and methods will be utilised in pursuit of realising the objectives of the study. Enhancing learners' problem-solving skills also means that teachers scaffold learning, using whatever material available (Kincheloe, 2004:4) to instil conceptual knowledge, skills and tools needed for problem-solving (Yu, Fan & Lin, 2015:2).

2.8.2 Mathematical Word Sums

According to Conley (2013:5), word sums as contained in the content areas, Numbers, Operations and Relationships, Patterns, Functions sand Algebra, Space and Shape, Measurement and Data Handling are mathematical sums extracted in words instead

of numbers. They serve as a platform where mathematical terms and concepts are explained to learners, providing guidance for linking classroom mathematics with lived experiences. This requires learners to understand the text so that they come up with the solution to solve the problem. Chapman (2006:212) perceives word sums as a basis of incorporating the real world into mathematical education, motivating learners to comprehend the significance of mathematical concepts by developing their critical and problem-solving skills. In addition, Pooran (2011:9) and Ladele (2013:17) view word sums as mathematical sums presented in words and numbers for the purpose of making a tangible level of understanding from an abstract level of thinking. Furthermore, Tambunan in National Council of Teachers in Mathematics (NCTM, 2019:294), views word sums as story problems that are not clear, but require reasoning, analysing, prediction and logical thinking to achieve the desired goal This will be possible when teachers design activities that will stimulate learners' attention where their prior knowledge is considered in order to link it to the new knowledge for a deep conceptual understanding of abstract ideas (Quirk, 2010:14).

2.9 LITERATURE REVIEW ON CHALLENGES THAT TEACHERS FACE WHEN TEACHING WORD SUMS

This section presented reviewed literature in identifying challenges facing teachers during the teaching and learning of word sums in a grade 4 class and to find solutions to the identified challenges. It also discussed conditions towards the successful implementation of the strategy, the hindrances that might impede the strategy and how to circumvent them and the indicators of success towards the successful implementation of the strategy to enhance grade 4 learners' problem-solving skills in word sums.

According to Mukherjee and Garain (2008:94) and Conley (2013:6), solving word sums is a process involving the rules, procedures and conceptual understanding for learners to be able to incorporate their existing knowledge into the new, in order to achieve the intended goal. Following is the section that reviewed literature for the purpose of improving grade 4 learner's problem-solving skills in word sums.

2.9.1 Challenges in the teaching and learning of word problems

This section discusses the challenges teachers are facing when teaching word sums to grade 4 learners. Solutions in the teaching and learning of word sums, conditions under which the strategy will be implemented, anticipated threats during the implementation of the strategy and how to circumvent those threats and evidence towards the successfully implemented strategy in the teaching and learning of word sums, will be highlighted.

2.9.1.1 Difficulties in understanding mathematical language in the teaching and learning of word sums

The research carried out among Filipino children revealed that children encountered challenges in comprehending mathematical language, in order to make meaning of the texts in word sums in grade 4 classes. (Phiri, 2014:1). This is because of the transition from being taught in their home language in the previous grade to being introduced to English as Language of Learning and Teaching in grade 4, which is a language barrier. In order to be able to solve word sums, which are centred around all content areas, teachers need to engage learners into activities that allow them to solve problems in contexts. This would be possible if commutative and associative properties of operations are used in teaching word sums without telling learners names of the properties, but teaching them how they can be used in making calculations easier (DBE, 2012:41) For instance, eight elephants were walking with their calves. How many elephants were there in total? Learners should be able to say 8+8=? and 5 apples + 4 oranges +3 bananas = How many fruits? Learners need to be told that numbers can be added in any order, but with subtraction, learners need to know that we subtract a smaller number from the bigger one. After completing the number sentence, learners can be asked to explain what they notice in their own words or they can be asked to make up their own problems to see if they have a mathematical understanding of word sums.

The multiplicity of bricolage, therefore was essential in making life easy for grade 4 learners when the bricoleurs applied varied theories, approaches and methods for better understanding of mathematical word sums. Narrative bricoleurs explained difficult texts in simpler language for better understanding, while interpretive bricoleurs

employed various theories and methodological bricoleurs applied different methods for grade 4 learners' understanding of word sums (Van der Merwe, 2014:27). Gersten, Beckmann, Clarke, Marsh, Star and Witzel (2009:26) concur that difficulties in solving word sums can hinder learners' successes in the mathematical arena. However, Grade 4 learners need to first adapt to mathematical concepts (Blease, 2014:33) presented to them in English, familiarise themselves with mathematical language to comprehend written texts and interpret questions before working out the solutions.

Furthermore, learners in grade 4 experience a lot of misconception, and end up not knowing what they are supposed to do, and as a result they fail to contextualise the concept (Cambourne, 2002:37), for instance, there were twelve sweets on a plate, Sipho ate four and Bheki ate three. How many sweets were not eaten? Some learners will confuse the verb ate with the number 8, and will end up having, 84 and 83, and not knowing what to do with these two big numbers. Teachers need to plan activities that are adaptive to learners (Estyn, 2011:13). Learners need to recognise various type of word sum structures and be able to apply a correct operation to solve the problem (Powell, 2011:5). Furthermore, learners need clarity on the direct meaning of the word before tackling the problem. For instance, Susan had money in her purse. Her mother gave her R20. Now Susan has R80. How much money did she have in the beginning? Without understanding the text, some of the learners will just say R20 + R80 = R100, when it is not the case. Teachers need to make these learners understand the word "beginning", which is key to solving this problem. Once they understand that before Susan was given R20 she had some money in her purse, they need to think that at the beginning it is unknown, of the unknown money she had before, plus R20 money she was given by her mother. Altogether add up R80 of which mathematical is written as R--+R20=R80. In this case, grade 4 learners get to formulate the mathematical equation for the inverse operation for addition, which is subtraction that can also be used in order to get the missing amount, for example: R80-R20=R60. This means that Susan had R60 before she was given R20. In conclusion, bricolage, which is the lens to the study was evident where multiple approaches to achieve the desired goal, were utilised.

2.9.1.2 Challenges of relating mathematical language and English as language of learning and teaching

According to Essien (2013:8), teachers are struggling to relate mathematical language with English as LoLT, in a manner that makes the LoLT simpler for learners to understand concepts, which they battle to comprehend. Meyer (2014:7) asserts that Reciprocal Teaching (RT) approach has been proven by many researchers to enhance learners' comprehension of text and solving of mathematical word sums, using different cognitive reading comprehension strategies. According to McAllum, 2014:26) reciprocal teaching is an approach to teaching, intended to improve reading and comprehension skills needed for metacognition where learners' experiences are brought into a learning environment. Furthermore, it is a strategy that scaffolds learning through group interactions, using pre-existing knowledge learners have to emancipate one another. Ford (2009:3) in the learning environment attests that the more learners are engaged in reading activities, the more vocabulary they acquire that assist in the understanding of word sums. Vocabulary acquisition is what grade 4 learners need in order to understand and solve word sums. However, teachers should try by all means to enrich grade 4 learners' minds through reading strategies, such as scenarios and case studies (Malebese, 2016:68) that incorporates incorporate mathematical language for word sums to be solved. Using scenarios and case studies make it easier for learners to understand word sums better, because they have language in them that needs to be translated into practical examples instead of using numbers that have no meaning to young learners, thus, in 10÷5 =? not all learners get the sum right, because of lack of understanding. Whereas in the case of a scenario, there is a lot of reading to be done even at home where there is extra assistance from parents. Similarly, reading strategies enhance learners' understanding before attempting to solve the problem posed. In addition, reading allows learners the opportunity to consolidate their thoughts and make new meaning. Once grade 4 learners are proficient i English as LoLT, teachers do not experience challenges when relating mathematical language to English. In her writing, Quirk (2010:16) suggests that word sums can be utilised as a foundation of incorporating the actual world in mathematics learning, because real life experiences can be expressed in word sums for learners to solve, to enhance their problem-solving skills. In another example, learners were asked to bring 2 pencils, in order to identify the longest. After identifying

they were told to measure the lengths of 2 pencils that belonged to Nolo and Lolo. Findings revealed that Nolo's pencil was 16cm and Lolo's 12cm (Potgieter, Ladewig, & Pretorius, 2009:128). In addition, learners were asked to tell which one was the longest, and by how many centimetres. The answer was that Nolo's pencil was the longest and by 4cm, which in short was written as, 16cm-12cm=4cm. Furthermore, they were asked to put the symbol for bigger than in, comparing the lengths for the pencils. This is how they did it: 16cm > 12cm. From this activity learners were expected to visualise, calculate and compare, which is what the multiplicity of bricolage entails. Words such as longest, bigger and length are keywords that this activity was centred around. When grade 4 learners have acquired a vocabulary in English, as language of learning and teaching, they are likely to understand mathematical language. However, teachers should relate mathematical language to English, in order to enhance grade 4 learners' problem-solving skills in word sums.

2.9.1.3 Lack of innovative teaching practices in mathematics classrooms

According to Van der Merwe (2014:27), old teaching practices and little basic content knowledge lead to poor standards of teaching in South Africans schools. This is because of the curriculum change, which does not make proper and adequate teacher training programmes available in preparation for curriculum implementation (Scott, Teale, Carry, Johnson & Morgan, 2009:341), which leads to poor learner performance in word sums. Teacher training programmes are normally scheduled for at least 4 hours in a normal working day, which is not enough time for capacity building. Teachers are not properly equipped with the skills they need to enhance learner performances and are expected to perform miracles in producing good results. Another contributing factor is that they have limited resources such as Teaching and Learning Material (TLM,) including textbooks, mathematical instruments and adequate time to go for teacher-orientation programmes on the latest educational trends, to be able to achieve the intended goal. This leads to teachers resorting to outdated teaching practices, such as reading from the book, and teaching mathematics abstractly, which has little or no impact in enhancing learner problem-solving skills in word sums. Teachers' approaches that deprive learners' opportunities to work independently, and cooperatively with fellow learners (Vygotsky, 1986:188) are all

examples of outdated teaching practices and many more other methods, such as rote learning, that were used during the positivism period of the qualitative research (Denzin & Lincoln, 2008:20).

Outdated teaching practices also entails methods where teachers do not guide learners towards the correct answer but instead, they simply give out answers to learners as feedback after the assessment (Quirk, 2010:27). Outdated teaching practices involve activities where teachers do not create a platform of pairing learners in small groups (Blease, 2014:41) where they could interact with one another, exchanging ideas instead of listening passively to teachers who dominate the learning environment. Word sums can never be learnt abstractly, and this is the reason why pictures, drawings, diagrams and visual representations are used to enhance problem-solving skills in a mathematics classroom (Poch *et al.,* 2015:1). Following is an example where the teacher tells leaners to do calculations on the sums to follow: (a) How many legs do 5 chairs have? (b). Half a ruler is 15cm. How many cm are 6 of them? (c) A farmer packs 45 eggs in a box that holds 30 eggs, how many eggs will be left over? A teacher asks learners to copy them in their workbooks while he is busy with something else. The example above shows lack of Pedagogical Content Knowledge. The teacher could have scaffolded learning and guided learners instead of giving feedback without explanations of how he reached the answers. The teacher could have assisted learners in getting answers right, but not give them the answers for effective teaching. He or she could have asked learners that got the answers correctly to help those that did not.

2.9.1.4 Insufficient Pedagogical Content Knowledge in the teaching of word sums

Pedagogical Content Knowledge, which according to Ball, Thames and Phelps, (2008:339) focussed on general aspects of teaching and with the content knowledge teachers have for the subject. These researchers attempted to infuse content with teaching practices and debated that unique subject matter is specific to professional knowledge for teaching (Hoadley & Jansen, 2013:105). PCK is the name given to professional knowledge, which entails knowledge domains, such as content knowledge, general pedagogical knowledge, knowledge of educational aims, goals

and purposes, knowledge of learners' curricular and knowledge of educational contexts (Hurrell, 2013:54). According to Koehler and Mishra (2009:64), PCK is the idea of interpreting the subject matter using various techniques, strategies, approaches, theories and methods during teaching and learning. Unavailability of PCK in the mathematics settings can only mean that teachers are not effective and efficient with curriculum delivery. They assume that learners are ok with just one example before they are able to work on their own, instead of giving more examples for deeper understanding, for instance, in four pencils plus five pencils equal to a place holder. Teachers should mediate learning by asking learners to write a number sentence for the sum before doing the necessary calculations, which is (a) 4 pencils + 5 pencils=? pencils or (b) 4 pencils +? pencils = 9 pencils or (c)? pencils + 5 pencils = 9 pencils. In doing so teachers can use different approaches to teaching learners' the addition concept.

Similarly, Blease (2014:24) attests that having the content knowledge only, without the techniques of imparting that knowledge, is not enough for reaching the end goal. However, teachers need to have a complete understanding of the content and the approaches to teaching that content. This was raised in the National Education Evaluation and Development Unit Report (NEEDU, 2014:44), and also should consider the existing knowledge learners have in order to build on it, for the successful teaching of word sums. Infusing the content, in different approaches, multiple theories and multiple methods of bricolage in the teaching of mathematical word sums, makes teaching easier and learners' problem-solving skills in word sums are enhanced (Mishra & Koehler, 2006:1027).

In conclusion, this section discussed the challenges teachers and learners face during the teaching and learning of mathematical word sums. However, it was evident that teachers have not been given enough time to be capacitated with innovative methods of teaching word sums effectively, in order to enhance problem-solving skills for grade 4 learners. On the side of learners, they are still struggling to understand word sums, because of the language barrier. The language in which mathematics is taught in the grade they are in, made it difficult for them to master word sums. This is reason enough to find solutions to overcome the intricacies both teachers and learners encounter in the teaching and learning of mathematical word sums in a grade 4 class.

2.9.2 A review of literature for formulating strategy to identified challenges

This section discusses solutions to enhance problem-solving skills for grade 4 learners' in word sums. Topics to be covered are nurturing learners' mathematical language in the teaching and learning of word sums, innovative teaching practices to enhance problem-solving skills and usage of visual representation to enhance problem-solving skills in word sums.

2.9.2.1 Nurturing learners' mathematical thinking. In the teaching and learning of word sums

Bicer (2013:1), supported by Gavin and Casa (2013:140) attests that learners' mathematical logical thinking first needs to be grown by nurturing their mathematical thinking and that levels of skillful thinking are necessary for improving problem-solving skills, which serve as a key element for learners' problem-solving in mathematical classrooms. This will succeed when teachers are developed professionally, improving their pedagogical skills in assisting grade 4 learners with their own skills. Attending workshops and other teacher training programs will assist teachers with the integration of technology and pedagogical content when they teach learners (Lee & Tsai, 2010:1). Ashlock and Wright (2001:8) mentioned that as children are in a process of learning mathematics, they need to learn the meaning of a new vocabulary with a completely different meaning to what they know. For instance, the phrase "altogether'' means "to add" in a mathematical context and completely a different story in language. Another example is of a word "left" in mathematics, which means "remaining" after subtraction, but is a past tense of leave in a language. Capraro, Capraro and Cifarelli (2007:360) assert that semantics, word identification and vocabulary are important cognitive attributes in solving word sums. Grade 4 learners are in the transition phase; meaning they were taught mathematics in their mother tongue in the previous grade and now the language of instruction changes from vernacular to English in grade 4. However, their mathematical language needs to be shaped and made better by teachers using whatever material at their disposal to enhance learners' problem-solving skills in word sums. In doing so, narrative bricoleurs just tell learners important keywords that normally appear when word sums are taught. In this statement: (a) twelve boys plus eleven girls equal to twenty-three learners altogether, which is interpreted as 12

boys+11 girls=23 learners, where plus means (+) and equals (=). Also, in (b) the teacher had seven sweets and gave four sweets to two learners. How many sweets did he/she have left? This is interpreted as 7- 4= 3, where 7 is the total number of sweets and gave represented (-), which means subtract or take away, and 3 is the number of the remaining sweets with the teacher. The traditional period of bricolage worked well with the above examples, as concrete objects were used as examples to enhance problem-solving skills in word sums.

2.9.2.2 Integrating mathematical language and vernacular languages in the teaching of word sums

In Nigeria, Jegede (2012:41) mentions that in situations where there are perceptible learning difficulties in learners' understanding of word problems in LoLT, teachers divert to learners' home language, which helps learners retell their thoughts, which allows them to comprehend word problems. Researchers have revealed that the use of English as a medium of instruction has created many problems in the learning of word sums in mathematics for grade 4 learners (Jegede, 2012:41). Setati (2002:113), has supported the use of learners' mother tongue to explain the concepts and texts learners struggle to understand, when presented in English, in order to solve mathematical word sums. In addition, Jegede (2012:46) regards the use of the vernacular as a means to encourage learners to express their ideas freely in multilingual classrooms. However, the Department of Basic Education (DBE) supports the use of all official languages in teaching and learning in South African schools (DBE, 2012). Therefore, diverting to vernacular where English is difficult for grade 4 learners to understand mathematical word sums, makes it easier for grade 4 learners to communicate their ideas, which assist them in improving their problem-solving skills.

In the following example, learners were asked to write the times in different ways, for morning times we write (a.m.) and for afternoon times we write (p.m.)

a) Getting out of bed at 06:30,
b) Arriving at school at 7:30, (c) Playing soccer at 13:00, (d) Going home at 2:15. Telling learners in their vernacular that 06:30 can be written as half past six in the morning or 6.30 a.m. is allowed, because the teacher is still the source of

information. In return learners will follow the example and complete the remaining times. They can write their responses as follows:

c) Arriving at school at 07:30 is half past seven in the morning or 7.30 a.m. or seven thirty a.m.
d) Playing soccer at 13:00 is 1'oclock in the afternoon or 1 p.m. or one o'clock p.m.
e) Going home at 2:15 is quarter past two in the afternoon or 14.15 p.m. or fourteen fifteen p.m. (Potgieter, Ladewig & Pretorius, 2009:47). The multiplicity of bricolage is portrayed in the above examples, because it shows times in different versions. Nonetheless, learners can be able to distinguish between analogue time and digital time with the help of the figure below, where the first diagram shows analogue time and the second one digital time.

The teacher can ask learners the following questions:

a) What time is shown on both watches' faces?
b) Looking at the projected times on the watches, how many minutes are left before it is time for learners to go home? Learners' responses: +

The time on the watches is two o'clock, and (b) fifteen minutes are left, because time to go home is fourteen fifteen.

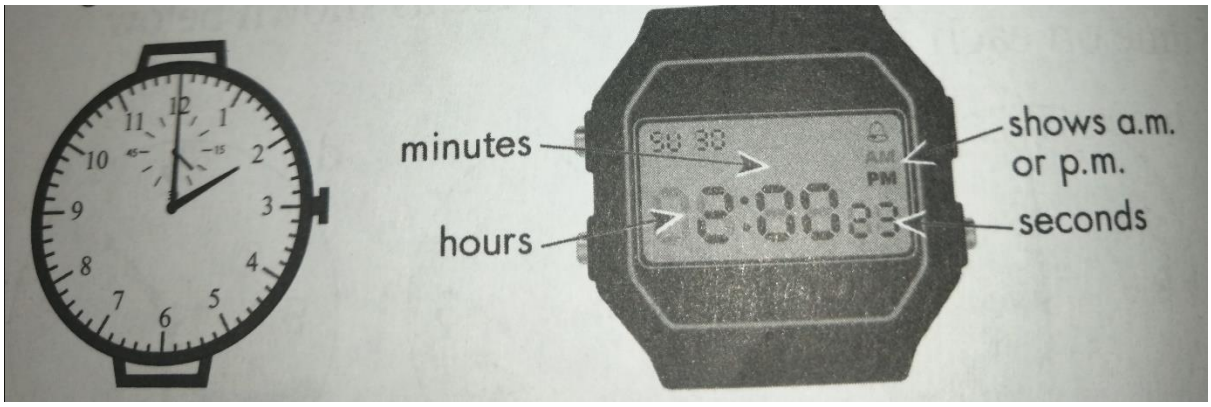


Figure 2.1: Showing analogue time and digital time (Source: Potgieter, Ladewig & Pretorius, 2009:46)

In conclusion, the multiplicity of bricolage allowed the researcher to use watches as practical example, showing different versions of writing time, which learners need to know in the learning of word sums.

2.9.2.3 Exploring innovative teaching practices to enhance problem-solving skills in word sums

The focus of the study in this section is on writing as an agency of communication to attain understanding by sharing opinions, applying knowledge and skills (Blease, 2014:33), because writing is the most influential tool in a mathematics classroom.

Research in the mathematics education department, has revealed that incorporating writing into the mathematics classrooms expands both mathematical content learning and learners' mathematical problem-solving skills (Bicer, Capraro & Capraro, 2013:363), because the more learners are engaged in written activities, the more they apply the knowledge and skills they gained proficiently. In her work, Blease (2014:44), mentions that learners who struggle in speaking the language often encounter difficulties in writing the language. It is therefore empirical for learners to be able to speak and read the language before attempting meaningful written activities that enhance their problem-solving skills in word problems.

Bicer *et al.* (2013:364) in their work assert that writing is the most influential tool in a mathematics classroom, because it gives learners a platform to consolidate what they have learnt and what they know into writing, which will allow them to always reflect and improve on. Blease (2014:45) claims that mathematics can never be taught in isolation and abstractly, because it uses concepts, signs, symbols and steps, which learners need to master, in order to advance their problem-solving skills. However, keeping a journal is therefore essential in mathematics classrooms, because it benefits teachers in record-keeping and as evidence of curriculum coverage and learner progress (Bicer *et al.*, 2013:363).

2.9.2.4 Relevant Pedagogical Content Knowledge in the teaching and learning of word sums

Teachers need to be vigilant in choosing the content that is relevant to the age and the grade of the learners whose problem-solving skills they want to enhance (Koehler & Mishra, 2009:64). This means that teachers should choose the content that is neither below nor above the level of grade 4 learners in preparation for the enhancement of their problem-solving skills. In addition, relevant PCK also embraces well-planned

activities that complement relevant teaching and learning material for effective teaching and learning of word sums (Ball *et al.*, 2008:4). The team agreed on the notion of always taking into consideration learners' prior knowledge, whenever a new concept is to be introduced. This simply means that teachers should always build on what learners already know and proceed to the unknown (Wadlington & Wadlington, 2008:5). For instance: if five boys are all wearing school shoes, how many shoes are there altogether? Learners should be able to write it as: 2+2+2+2+2= 10 shoes, which means 2 shoes for each boy, and 10 shoes for all the 5 boys. To explain it further, a bricoleur could say, another way of arriving at the correct answer is 2×5=10 boys.

PCK also means teaching learners from the simple to the complex approach to enhance grade 4 learners' problem-solving skills in word sums, for instance: nine marbles are to be shared by three boys, and how many marbles do each boy gets? With this example, the team agreed on bringing 3 boys to the front. One learner was asked to give marbles, one by one to the boys until nothing was left. Learners were then asked how many times each boy was given a marble. The answer was 3 times. Another question to learners was: how many marbles did each boy have. The answer was 3 marbles. The bricoleur told learners that nine marbles shared by three boys equals three marbles, which mathematically is written as 9 marbles ÷ 3=3marbles. Learners were also told that to share in this activity meant to divide equally, and the inverse operation for division is multiplication (×), which is written as 3 marbles × 3=9 marbles. This also meant that 3 marbles+3 marbles+3 marbles=9 marbles. In addition, PCK embraces informal assessment during lesson presentation to check if learners are still following. This gives the bricoleur an opportunity to also assess himself or herself, whether she or he is still on the right track

For this study, PCK encompasses the content knowledge that is relevant to the age and the grade of learners, well planned activities, which are aligned with relevant resources presented in multiple theories, as well as perspectives and methodologies of bricolage for deep conceptual understanding of mathematical word sums. In light of the above, mathematics teachers should possess adequate PCK for effective teaching and learning of mathematical word sums.

2.9.3 Critical conditions for the successful implementation of the strategy in the teaching and learning of word sums

This section discusses conditions towards the successful implementation of the strategy in the teaching and learning of word sums under the following headings: Conditions towards nurturing learners' mathematical thinking in the teaching and learning of word sums, conditions of integrating mathematical language and vernacular in the teaching and learning of word sums, conditions to lack of innovative methods in mathematics classrooms, and conditions relevant PCK in the teaching and learning of word sums.

2.9.3.1 Conditions towards nurturing learners' mathematical language in the teaching and learning of word sums

Nurturing learners' mathematical language in the teaching and learning of word sums comes with a number of conditions for the strategy to be successful. One: amongst many, teachers can use a team-teaching approach. This is an approach that involves two or more teachers who are concerned with exchanging ideas with an aim of enhancing learners' problem-solving skills in the learning environment (Jang, 2006:177). The purpose of team-teaching from an educational perspective, is to assist learners achieve higher levels of thinking and integration in their learning (Letterman & Dugan, 2004:3). Furthermore, it gives teachers a platform of choosing what resources and approaches they could use and what assessment techniques to be administered when the strategy is being implemented to enhance learners' problem-solving skills. Wentworth and Davis (2002:23) assert that team-teaching benefits learners, because it increases a collaborative teaching environment amongst teachers (Wadkins, Miller & Wozniak, 2006:119) and learner-teacher interaction towards effective teaching and learning.

Team-teaching allows the novice teachers opportunities to acquire various skills and techniques from experienced teachers that they can use in their daily teaching (Helms, Alvis & Willis, 2005:30). Not only the skills and techniques, but also the values and attitudes on how to address all learner behaviour during teaching and learning, which can be acquired in team-teaching (Wentworth & Davis, 2002:16). Team-teaching is one of the techniques that also enhances learners' self-esteem, as well as social and

spiritual aspects of their growth in all spheres of life, especially in solving word sums grade 4 learners struggle in. For instance, if one teacher does not succeed in his or her attempts to satisfy the learner's needs in a particular field, another teacher zooms in to assist or intervene, by using another approach best suitable, in order to reach the end goal. The multiplicity of bricolage was employed through shared interactions across all five content areas as were mentioned earlier in the study. Collaboratively, duties were discussed and delegated amongst the co-researchers and the strategy was implemented in a number of planned activities that assisted teachers in enhancing problem-solving skills for grade 4 learners.

2.9.3.2 Conducive conditions in integrating mathematical language and vernacular in the teaching and learning of word sums

This section discusses conditions in integrating mathematical language and vernacular in the teaching and learning of word sums. DBE (2011:8) states that mathematics is a language that uses symbols and notations to describe numerical, geometric and graphical relationships. However, learners need to use mathematical language, in order to communicate mathematical ideas (Setati, 2002:9) in a mathematics classroom. It is therefore the duty of mathematics teachers to equip learners with mathematical language, in order to enhance their problem-solving skills. The medium of instruction in which mathematics is taught has been challenging to grade 4 learners. However, teachers need to maintain a balance between mathematical language and English, in order to enhance problem-solving skills for grade 4 learners. This would be possible when teachers first integrated mathematical language and learners' mother tongue for conceptual and procedural understanding before the language of teaching and learning. Using the learners' mother tongue in a mathematics setting, is a means of scaffolding learning for better understanding concepts learners struggle to comprehend. Teachers are forbidden from teaching learners in vernacular languages for the reason that it prohibits learners from acquiring English vocabulary. However, vernacular in mathematics classrooms is used for facilitating learning, to explain difficult words learners fail to conceptualise, to emphasize an important point, to interject in a conversation and for giving clarity.

Integrating mathematical language and vernacular also meant that teachers allowed learners to use their mother tongue to interact informally in group discussions, exploring and arguing their ideas and interpretations before engaging in formal writing of mathematical word sums. Allowing learners to use vernacular in mathematics settings, is the support needed while they continue to develop proficiency in the LoLT (Setati, 2002:14). Incorporating learners' mother tongue and mathematical language brings joy to young learners in a sense that they freely engage in discussions without fear of being ridiculed, should they don't get things right. The pluralistic of bricolage is evident when teachers use languages interchangeably, in a wide repertoire of teaching strategies. In the example: 5 goats each gave birth to triplets. How many baby goats were there? The teacher explained the word triplets meant 3 baby goats (*amaphahla*) in isiZulu for conceptual understanding. Learners were allowed the opportunity to negotiate meaning in vernacular and came up with the solution. For instance, 3 baby goats + 3 baby goats +3 baby goats +3 baby goats +3 baby goats = 15 baby goats or 5×3 baby goats=15 baby goats (Pretorius, Potgieter & Ladeweg, 2012:226).

In conclusion, the above example is an indication that teachers need to integrate mathematical language and vernacular in the teaching and learning of word sums in order to enhance problem-solving skills for grade 4 learners.

2.9.3.3 Conditions to innovative teaching practices in the teaching and learning of word sums

The traditional way of teaching learners where teachers dominated in (Lin, 1998:162) the classroom, worked well during the positivism period. During that time the teacher was regarded as the only source of knowledge learners relied on (Denzin & Lincoln, 2008:13). However, that kind of teaching did not enhance problem-solving skills for learners, instead, it deprived learners of experiential learning where they could use their existing knowledge and experiences to discover solutions the problem posed, during learning of word sums. According to Kolb (2014:20), experiential learning is an approach to teaching and learning, based on the reality that people learn best through experience. Incorporating other learner-centred approaches, such as peer-tutoring and active learning, benefit the learners more than teacher-centred approaches in the learning of word sums.

Peer-tutoring is the kind of learning where learners of the same or different age groups assist one another in classroom activities, by sharing ideas and solving mathematical problems other learners struggle to understand (Derrick, 2015:3). He further states that tutoring allows the tutors to find different ways to interact with the tutees and find various techniques of tackling difficult concepts in the language that is understood by their peers. In addition, Harvey and Kenyon (2013:5) concur that when learners are seated in groups, and assisted by able learners, they are more likely to understand a concept than when they are working independently. Learners seated in rows, listening passively to a dominating teacher are deprived the opportunity to explore and discover their potential through cooperative learning. However, MolokoMphale and Mhlauli (2014:124) advocate that engaging capable learners in tutoring less capable learners allows the latter to ask questions where they don't understand, instead of asking the teacher, whom the learners fear.

In conclusion, learners' problem-solving skills are enhanced in conditions where teachers incorporate innovative teaching practices that allow learners to share ideas, in order to find solutions for themselves (Felder & Brent, 2009:3). Bricolage, with its multiplicity, is one theoretical framework that works the best in utilising innovative teaching practices in enhancing problem-solving skills in word sums.

2.9.3.4 Conditions of sufficient Pedagogical Content Knowledge in the teaching and learning of word sums

Karaman (2012:59) asserts that for the teachers to be able to develop learners' potentials in solving word sums, they need to acquire Pedagogical Content Knowledge (PCK) and Subject Content Knowledge (SCK) because opportunities for the innovation of constructs to support by scaffolding the knowledge are being created through Pedagogical Content Knowledge (Hurrel, 2013:54). He also points out the way teachers teach influences the quality of results learners get. This means that the good learners are taught by well-trained and well-informed teachers with adequate Subject Content Knowledge, pedagogical knowledge, as well as knowledge of educational contexts (Ball *et al.,* 2008; Englehart, 2008).

According to Ball *et al.* (2008:3), PCK entails a comprehension of the factors that contribute to effective learning of specific topics, bearing in mind learners' ages and

socio-economic status as they come to the learning environment. They further mention that PCK infuses practical teaching with content knowledge of a particular subject, ensuring that what was taught adheres to the curriculum and is within the paradigms of teaching as a profession, using multiple theories and methods of bricolage to assist improving learners' problem-solving skills in word sums (Lee, Brown, Luft & Roehrig, 2007; Nason, Chalmers & Yeh, 2012; Hurrel, 2013:56) .The authors state in their work that teachers without PCK and SCK, no teaching experience will not be able to equip grade 4 learners with the necessary problem-solving skills to solve the word sums they struggle to master. For instance, when a teacher wants to teach learners similarities of a rectangular prism and a cube, and also differences between the two, an inexperienced teacher can just tell learners that the two prisms belong to the family of the quadrilaterals, with four sides each and each have four right angles as similarities. Furthermore, their differences are that all sides of a square are equal, while a rectangle has two opposite equal sides. In contrast, an experienced teacher can allow learners to explore and discover on their own what similarities and differences are between a square and a rectangle.

The irony in this example is that the method used is only theory, where the teacher just conveys the information to the learners, which cannot enhance problem-solving skills for learners, and this was used by the positivists during the traditional period. Instead, cooperative learning and group discussions would be appropriate in this lesson where learners would be made to identify what is similar and what is not between the two quadrilaterals, by using manipulatives or diagrams and even pictures. Learners could even go as far as doing a hands-on activity by measuring both the length and width of the two objects. In doing so, the teacher would be developing learner centred approaches around the multiplicity of bricolage as the theoretical framework of the study. The objectives of the study would be achieved if teachers would have adequate PCK and SCK and adopt the multiplicity of bricolage in an attempt to enhance problem-solving skills for grade 4 learners.

In conclusion, teachers need to develop activities that will actively engage learners to explore and discover the solutions, rather than being told the solutions to the problems (Hill & Charalambous, 2012:561).

2.9.4 Threats and risks impeding the successful implementation of the strategy in the teaching and learning of word sums

The section discussed the threats and risks that are stumbling blocks in the teaching and learning of word sums. As the study progressed, some of the threats were picked up along the way. Amongst those are: risk factors that threatens the fostering of learners' mathematical thinking in the teaching and learning of word sums, factors in integrating mathematical language and vernacular languages in the teaching of word sums, factors impeding innovative teaching practices in enhancing problem-solving skills in word sums and factors hindering the sufficient Pedagogical Content Knowledge in the teaching of problem-solving skills in word sums.

2.9.4.1 Factors threatening the fostering of learners mathematical thinking in the teaching and learning of word sums

Learners' mathematical thinking needs to be fostered for their problem-solving skills to be enhanced. This is possible when a variety of resources are incorporated with the content in mathematics classrooms when word sums are taught. This idea was supported by Bada and Olusegun (2015:67) who was against the teaching of word sums abstractly, with the exclusion of resources. Resources in mathematics classrooms are essential for fostering learners' mathematical thinking, in order to be able to solve word sums. Resources uplift the efficiency and the quality of education in our country and across the globe as well (Okongo, Ngao, Rop & Nyongesa, 2015:135). According to Lyons (2012:135), teaching and learning is a process that entails a wide range of resources, such as Teaching Learning Material (TLM), physical facilities and more specially the Human Resource (HR). Furthermore, these three are basically the main components of Teaching and Learning Resources (TLR) to raise the bar of quality education in South African schools and globally. Our schools require well trained teachers (Fantilli & McDougall, 2009:816) who utilise TLM to its fullest in a conducive learning environment where physical resources are available for effective teaching and learning to take place (Aydin, 2016:59). The absence of one of the three components impedes the ultimate goal of enhancing learner performance in general. Researchers have revealed that learners' mathematical thinking is fostered by infusing

resources, such as concrete objects, instead of teaching word sums the traditional way (Young, 2015:4)

Poch *et al.* (2015:157) asserts that the use of a visual representative in a mathematical classroom has produced better results than in classrooms where mathematics is taught abstractly. Mathematical concepts presented in First Additional Language are new to grade 4 learners, therefore teachers have to use the scaffolders to assist them (Vygotsky, 1978:2). These scaffolders come in handy in forms of material resources like counters, textbooks, charts, clocks, shapes and the likes.

Textbooks are essential for learners to be able to read scenarios on word sums and extra exercises, in order to consolidate learning. Unavailability of these resources makes teaching and learning difficult for the teachers and leaners, which threatened the successful implementation of the strategy in enhancing problem-solving skills. Bricolage encourages the use of any material available to make something meaningful. This was not always the case, because other researchers made use of chalkboard only to write and learners did not have something else to read for reinforcement. To circumvent the issues of TLM, mathematics teachers need to bring as many resources as possible in a mathematics classroom, in order to avoid teaching word sums abstractly. In doing so, they are spreading the domain of bricolage and its multiplicity for enhancement of problem-solving skills.

2.9.4.2 Risk factors in integrating mathematical language and vernacular languages in the teaching of word sums

Every learner has pre-existing knowledge that they bring into the learning environment, which they build up on. Applefield, Huber and Moallem (2001:8) concur that no learner comes to a class without prior knowledge and this existing knowledge forms the basis of what is going to be learnt in the next grade. It is the knowledge they have that assists teachers to build up on as they interact with learners. It is evident that learners do not have the same level of understanding of mathematical concepts. These levels differ from child to child, because of the factors that affect the intellect of each learner. These levels include cognitive abilities, such long and short–term memory, visuospatial skills, processing speed and many more (Mokotjo, 2017:46). Other factors, which are barriers to children's learning are physiological, such as poor

eyesight, deafness, stuttering, etc. These factors may impede the pace at which learners perform, when completing some of the mathematical activities. Some learners take too long to conceptualise (Raoano, 2016:3) and require teachers to switch to outdated teaching methods, like the drill method, before they understand which is of little value when compared to learner–centred approaches that are currently utilised.

Learners with short-term memory and a low concentration span, take too long to assimilate complex mathematical concepts, such as multiplication and division (Bird, 2012:113). In such cases teachers switch to vernacular and also make use of manipulatives with an aim of scaffolding learning, which is supported by Mahofa and Adendorff (2014:14) and TIMSS (2015:17). In contrast, Gulzar (2010:30) argues that code-switching in mathematics classrooms deprives learners of the acquisition of mathematical language if it is used extensively. Shilamba (2012:13) is of the idea that integration of mathematical languages and vernacular should be minimal and not be prolonged for the benefit of learners. In addressing the issue of slow progressing learners, teachers need to arrange learners in groups and give learners a platform to interact amongst themselves, while other teachers are busy assisting other learners during learning. Arranging learners in this manner is in line with the modernist period, the second moment of bricolage, which allows a variety of approaches, theories and perspectives, in achieving the desired goal, but limiting learners from learning mathematics in their mother tongue.

2.9.4.3 Risk factors that impede innovative teaching practices in enhancing problem-solving skills in word sums

Innovative teaching practices are the essence of effective teaching and learning of mathematical word sums, which is contrast to the approach and methods used during the traditional period that gave power to the teachers only. According to Goos (2015:33), for the successful teaching and learning of word sums, teachers need to create a conducive learning environment, which comprises of a learning space and appropriate resources that benefit all learners in the mathematics setting. A conducive learning space is one that allows learners to be arranged in groups for the incorporation of learner-centred approaches that actively involves learners in the learning of word sums (Van de Walle, 2004:32). Learner-centred approaches like

cooperative learning and problem-based learning, allow learners freedom to engage themselves in hands-on activities. This is done by using counters and other real objects in making word sums more understandable with the guidance, but not the dominance of the teacher (Runyon, 2016:2). In addition, learner-centred approaches are active processes that fit into the learning paradigm where teachers assess learners' prior knowledge while making links between old and new concepts (Fantilli & Mc Dougal, 2009:815). However, this is possible when resources, such as concrete objects, are infused in the teaching and learning of word sums.

With constricted floor space, learners cannot use tangible manipulatives (Khoza, 2016:100) that will enhance their problem-solving skills in word sums. This is supported by Ladele (2013:68), in his work, when he says an unfavourable floor space hampered successful teaching and learning of word sums in African schools in Botswana and Zimbabwe, where learners were taught under the trees without physical resources to accommodate learners. These then propelled teachers to go back to traditional ways of teaching used during the traditional period of positivism. In conclusion, the modernist and the post-modernist periods of bricolage support the idea of using innovative teaching approaches that are essential in enhancing learners' problem-solving skills in word sums.

2.9.4.4 Risk factors that impede the sufficient Pedagogical Content Knowledge in the teaching of problem-solving in word sums

According to Hurrel (2013:55), PCK is teachers' understanding and the portrayal of how to assist learners understand the content, using a wide range of approaches in the learning environment. Research has revealed that inexperienced teachers have a limited range of PCK and this is one factor that threatens the teaching of word sums in grade 4 classes. Contrary to this, Kleickerman (2013:95) mentions that teaching experience alone does not compare with teaching expertise, but teaching methods are as much important in the development of PCK for effective teaching and learning.

According to Hill *et al.* (2008:90), teachers might have a deep knowledge of the content, but less knowledge of how learners learn the content or vice versa, that also threatens the teachers' PCK in the teaching of mathematical word sums. Hill and Charalambous (2012:560) are of the idea that Mathematical Knowledge for Teaching

(MKT) is a contributing factor towards effective teaching, therefore, teachers need to possess this kind of knowledge to foster their PCK, which in its absentia can hinder the teaching of word sums effectively. However, materials and professional development should support teachers so that they know what content, what resources and what approaches they can use (Setati, 2005:44) to enhance grade 4 leaners' problem-solving skills in word sums. In the case of employing the multiplicity of bricolage, teachers can vary the methods in teaching subtraction, for instance, breaking down of both numbers according to place value. It can be done in this manner:

- Calculate the number of girls in a grade 4 class of 68 learners, of which 32 are boys.
- Response should be like, 68-32=? Which is written as (60–30) + (8–2) = ?

Sixty subtract thirty is thirty and eight subtract two is six. Therefore, the number of girls in a grade 4 class is thirty plus six, which equals to thirty-six (36). In this example, is not only subtraction skill developed, but learners are taught how to write numbers in words (Potgieter, Ladewig & Pretorius, 2009:26). In light of the above discussions, using more than one method in teaching word sums enables the teacher the opportunity to see which method learners understand the most, because not all learners assimilate mathematical concepts at the same pace.

2.9.5 Indicators of success in the teaching and learning of word sums

Indicators of success in the teaching and learning of word sums are: effective understanding of mathematical text and keywords; effective integration of mathematical language and vernacular languages in the teaching and learning of word sums; effectiveness of innovative teaching practices in the teaching and learning of word sums and indicators of success of Pedagogical Content Knowledge in the teaching of problem-solving in word sums.

2.9.5.1 Effective understanding of mathematical text and keywords in the learning of word sums

Mathematics is taught in English in the intermediate phase, therefore grade 4 learners need to adapt to the LoLT, in order to understand mathematical concepts. This will be

achieved when reciprocal teaching approach is applied in a mathematical setting (Meyer, 2014:7). Reciprocal teaching, according to Quirk (2010:2), is the process where learners share ideas in small groups, interpreting the text, in order to solve the problem. It is during this process that learners equip one another with knowledge and skills they need to solve word sums, while the teacher facilitates leaning (Mazibuko, 2014:182; Vasay, 2010:161). During interaction learners' self-esteem is aroused and they also share values and develop a sense of respect for others.

Nevertheless, Fuchs, Schumacher, Long, Namkung, Malone, Wang, Hamlett, Jordan, Siegler and Changas, (2016:14) concur that once the mathematical keywords in a text have been explained and simplified, learners gain insight and are able to write algebraic expressions in solving the problem. Understanding mathematical text means that learners are able to demonstrate their thinking and counting skills to consolidate their knowledge of numbers (DBE, 2011:18) Grade 4 learners perform better when they know which equation suits the problem the best. For instance, 12 oranges fell from the tree, 9 more oranges fell from the same tree. How many oranges fell from the tree altogether? Grade 4 learners can calculate 12 oranges + 9 oranges = 21 oranges, because they have been taught that the word altogether means one should add (+), how much "more" also requires learners to add to get the correct answer. Learners need to be taught that they can check an addition calculation by subtracting, and vice versa. For instance, 21 oranges - 9 oranges = 12 oranges. This should be demonstrated using real objects for better understanding. According to the DBE (2011:43), applying an inverse operation to check solutions is one way of teaching addition and subtraction concurrently. In subtraction, success in understanding mathematical keywords means that learners understand words, such as difference, decrease by, less, least and many more. By giving learners as many contextual problems as possible, the multiplicity of bricolage is being demonstrated and learners' awareness of other content areas, social and environmental issues are developed.

2.9.5.2 Successful integration of mathematical language and vernacular languages in the teaching and learning of word sums

The idea of integrating mathematical language and languages was supported by many researchers (Winford, 2007:22-40). Grade 4 learners are known for struggling in

solving word sums, because of the transition of being taught mathematics in English. Lee (20106:45), supported teachers when switching to the mother tongue in situations where grade 4 learners cannot understand how to solve word sums. Code-switching does not mean that teachers are teaching mathematics in learners' mother tongue, but when they give clarity on what learners are expected to do and to provide metalinguistic commentary (Moschkovitch, 2004:167). Molotja (2008:2) in his work confirms that there was a higher academic performance in mathematics where switching to other languages was used, than in schools where English was the LoLT. Switching to other languages, vernacular in particular, enables learners to participate actively in cooperative learning activities (Rondina, 2019:327), because everyone uses their mother tongue freely when exchanging ideas and coding is being done; this then enhances learners' problem-solving skills in word sums.

Teachers code switch when they want to regain learners' attention and during lesson facilitation to emphasise the important points (Ahmad & Jusoff, 2009:49). Learners use their mother tongue when they interact with peers during their learning. This makes it easier for them to help one another in interpreting the text and using the appropriate equation in solving word sums, because the language learners understand better is their mother tongue (Jegede, 2012:46). He further attests that learner performance improved in Nigerian schools where integration of mathematical language and languages was applied in mathematics classrooms. Even though not all learners can benefit from the code-switching approach, at least the majority of the class can benefit. This is not because they do not understand their mother tongue, the reason is that they lack conceptual understanding. Learners gain confidence and they gradually become relaxed around their peers, thinking critically and their self-concept is uplifted, as they come up with answers to some of the questions asked. As a result, their problem-solving skills improve.

Following is an example that drove the teacher to code-switching to enhance learners' problem-solving skills: Sindi and Fundi are babysitting for four hours. Sindi works for one hour and Fundi for three. They are paid R100 in total. (a) How much money will each of them get? (b) What fraction of time did each of them work? A lot of answers would be given by Grade 4 learners, for instance, Sindi would be paid R10, because she worked for 1 hour and Fundi would get R90 because of the hours she worked. Others would say R20 for Sindi and R80 for Fundi. Their responses would be based

on assumptions considering the hours they each took babysitting and not of practical calculations. Learners could not be able to calculate the fraction part. However, they would need the guidance from the teacher to get to the correct answer. That is where vernacular languages come in, because the teacher would have to divert to learners' mother tongue for further explanation. At most 10 learners would get the first answer correctly, while the rest would fail to conceptualise.

For instance, the teacher would say: Sindi worked $\frac{1}{4}$ (which is 1 hour of 4 hours) and Fundi worked $\frac{3}{4}$ (which is 3 hours of 4 hours). She/he would continue to say, if we want to find out how much money each girl has, we could say $\frac{1}{4}$ of R100=? For Sindi and $\frac{3}{4}$ of R100=? for Fundi. To explain this further, learners would be asked how much is half of R100, which is R50 and that a $\frac{1}{4}$ of R100 is therefore R25, which was Sindi's pay. To determine Fundi's, pay, the teacher asked learners for how many hours did Fundi work? The answer would be 3 hours. Therefore, R25+ R25+ R25= R75 was Fundi's pay. Success would indicate that learners were able to compare the difference in sizes between one quarter, and three quarters and that each learner could earn as much as she worked. In light of the above, doing this activity diagrammatically was one way of employing the pluralism of bricolage as a lens to the study, where multiple approaches were applied to enhance problem-solving skills for grade 4 learners in word sums.

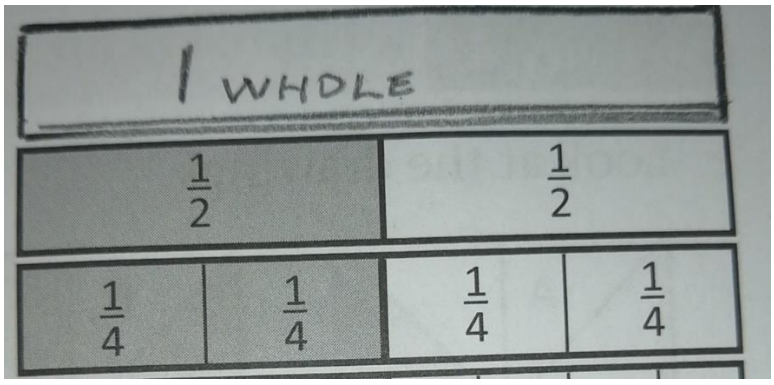


Figure 2.2: Showing how fractions can be used to solve problems in contexts (Source: Pretorius, Potgieter & Ladewig, 2009:109)

2.9.5.3 Effectiveness of innovative teaching practices in the teaching and learning of word sums

Writing is the most powerful tool in the teaching and learning of word sums. It is an approach to teaching whereby teachers engage learners in activities where they

participate more actively than listening passively to the teacher (Pierce & Fox, 2012:106). This approach is in contrast with the non-operational approaches that were employed during the traditional period of positivism where teaching was centred around teachers and textbooks in the learning environment. Furthermore, innovative teaching practices entail active learning, which embraces listening, reading and writing activities where learner dominance is the integral part of learning (Strangfeld, 2013:199). In active learning, learners construct their learning in more active ways than one. This includes group discussions, cooperative learning, peer tutoring, problem-based learning and experiential learning. In addition, writing in the mathematical classrooms is best suitable in the teaching and learning of mathematical word sums, because learners get assistance from the teachers, instilling knowledge through the multiplicity of bricolage, using different perspectives, different methods and different theories (Rogers, 2012:5) for deeper understanding.

While writing, learners get assistance from peers and also guidance from the teacher (Mayer, 2004:14) and are able to amend their mistakes instantly. Writing during peer-tutoring and group discussions benefits all learners in the group, because they interact with one another, sharing ideas. They somehow agree on the communicated idea and end up understanding the concept. Even though not all learners learn at the same pace as others (Salman, 2009:12), writing allows them an opportunity of reflecting back on their work when they are working at home, with or without parental involvement. Learners were asked to collect data on the mode of transport they use when going to school and to represent it on a tally table. From learner responses it was gathered that learners who walk total twenty-one (21), learners who use a bus are eight (8) and learners who use a taxi are eleven (11) in total.

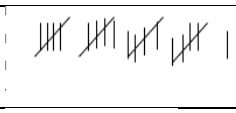
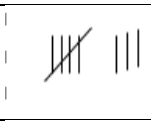
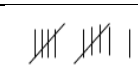
Different modes of transport		
Mode of transportation	Tally	Frequency
Walk		21
Bus		8
Taxi		11

Figure 2.3: Showing how data can be recorded on a tally table (Source: DBE, 2015:59)

Recording data in a tally table is one of the innovative teaching practices teachers can use to enhance learners' critical thinking, so that they are able to summarise data verbally and in written paragraphs. This is experiential learning (Kolb & Kolb, 2005:194), which is a process whereby knowledge is created through learners' life experiences.

In conclusion, if learners were to learn word sums abstractly, and not engage in writing practices, it would be difficult for them to analyse data represented in words, and also to convert those words into other forms, such as tallies (DBE, 2011:95). Lastly, by not engaging in writing activities, learners would not be able to work on their weaknesses and improve on their strengths in problem-solving.

2.9.5.4 Indicators of success of Pedagogical Content Knowledge in the teaching of problem-solving in word sums

According to Poch *et al.* (2015:1), a representation in mathematics is a process where the concepts are communicated diagrammatically towards an end product. Visual representatives come in diagrams, pictures and even symbols. Researchers postulated that visual representations are powerful tools in solving word sums, for the grade 4's in particular (Moyer-Packenham & Bolyard, 2016:11). Teaching mathematics abstractly is difficult for learners to understand, therefore translating mathematical texts into pictures and diagrams will enable grade 4 learners to understand word sums much easier (Toptaş, Çelik & Karaca, 2012:1122). Here is an

example: A teacher asked learners to write down different kinds of sports they liked on pieces of papers.

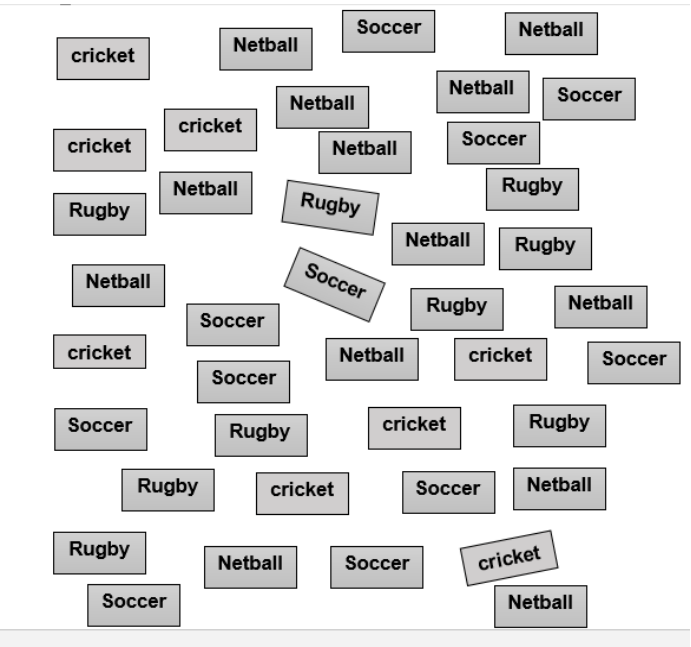


Figure 2.4: Learner notes on paper regarding their favoured sports

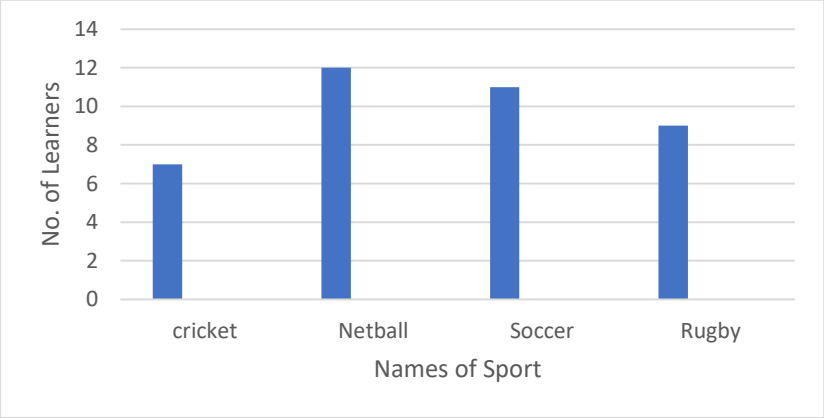


Figure 2.5: Indicating recorded data on a bar graph (Source: Potgieter, Ladewig & Pretorius, 2009:53)

The teacher asked learners to represent their responses on a bar graph. This is what their graph looked like. Learners were able to construct their own graph after doing a few examples with the teacher from their textbooks. Learners got to solve the problem and also learned to exchange the values of real-life experiences at their disposal. Teachers should give learners more examples of word sums to be able to master the concept (Carpenter, Fennema, Peterson & Carey, 1988:385). The above information

could also be represented on a pictograph for more knowledge acquisition and for learners to analyse graphs on environmental and socio-economic contexts (DoE, 2011:95).

Manipulatives should be used in mathematics settings for enhancing learners' problem-solving skills in word sums. Even slow progressing learners in the main stream schooling benefit from activities where diagrams and pictures are brought in mathematics classrooms (Berry, 2008:149). Bringing visual representations in a mathematics classroom will enhance grade 4 learners' cognitive, as well as their problem-solving skills in word sums (Rondina, 2019:327). To explain this further, the teacher came to class with 2 whole apples in a grade 4 class. He/she cut the first apple into two equal pieces, and asked learners what each piece was called. Learners answered by saying half or.$\frac{1}{2}$. The teacher further explained that half means one piece of two pieces. She/he then cut the second apple into four equal pieces and asked the learners what each piece was called. The response was a quarter. She/he further explained that a quarter means one piece of four pieces $\frac{1}{4}$. Furthermore, learners were asked which piece, between half and quarter, was bigger than the other. All learners replied by saying half is bigger than a quarter. The written answer was as $\frac{1}{2} > \frac{1}{4}$. She/he then asked learners to take pieces from the apple cut into 4 pieces and match them to the halves. She/he asked how many quarter pieces match half pieces? The response was 2 quarter pieces match each half. She/he wrote the answer as $\frac{1}{2} \approx \frac{2}{4}$, This meant that the value of half is equal to the value of two quarters. In light of the above, bricolage, allowed the researcher and the co-researchers to use a variety of approaches, theories and methods at their disposal to enhance grade 4 learners' problem-solving skills. This included team-teaching approaches, co-operative learning, problem-based learning with the aid of manipulatives for meaning making in the teaching and learning of word sums. Teachers' PCK is sometimes compromised due to the constraints in terms of resources, including time and curriculum coverage. However, not all learners benefit in the teaching and learning of word sums; some progress to the next grade having not achieved problem-solving skills.

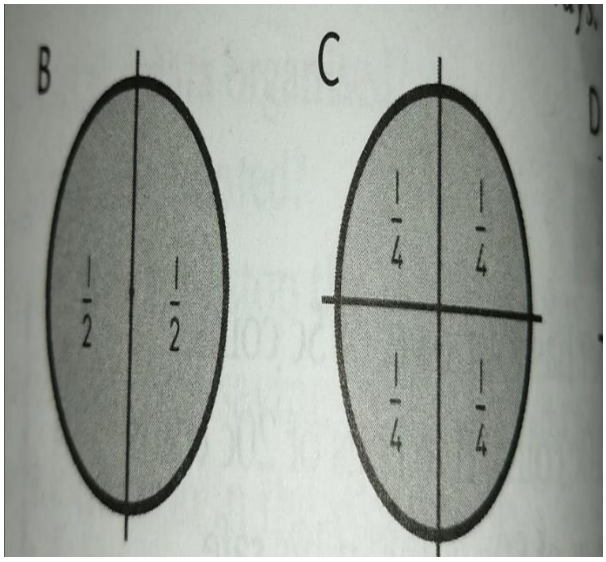


Figure 2.6: Showing how learners can construct their own drawings on fractions (Source: Raubenheimer & Jackson, 2012:93)

2.10 CHAPTER SUMMARY

This chapter discussed bricolage model as the theoretical framework that guided the study, its origin and background, the eight golden moments of bricolage and how each of them were useful for the study. Even though not all of them were beneficial to the study, some had limitations, which could not enhance grade 4 learners' problem-solving skills in word sums. Literature review, with the inclusion of some mathematical examples under the objectives and the appropriateness of bricolage in the study were discussed. Each objective was explained from various researchers' point of view and how it is linked to the study. The conditions under which the strategy was successful, the hindrances towards the successful implementation of the study and the elements indicating the success of the study, which included the teachers' PCK and the successful usage of innovative teaching practices that are influenced by learner-centred approaches, etc. were considered. This chapter made preparations towards the discussion of research methodology and design and the Participatory Action Research.

CHAPTER 3 :
RESEARCH EMTHODOLOGY AND DESIGN

3.1 INTRODUCTION

The study was aimed at enhancing mathematics for grade 4 learners' problem–solving skills in word sums. This chapter focused on the methods that were employed to guide it, how data was generated and also the analysis of the findings. Participatory Action Research (PAR) is an approach to research that was used to guide this study. PAR was best suitable for this study, because of its basic components that would be used in order to achieve the objectives of the study (Malebese, 2016:86). These components are the historical origins of PAR, objectives, formats, steps and principles, the role of the researcher, the relationship between the researcher and the co-researchers, ontology, epistemology and rhetoric, cyclical steps of PAR, which are the identification of the problem itself, developing a plan of action, which would entail a variety of activities. Implementation of a plan and lastly a reflection of all the activities followed. Re-planning would be done if necessary. The chapter also discussed the ethical consideration to protect the identities of the participatory members in the study. The roles of the team members were clearly defined and what methods were used to generate data and analysed using a Critical Discourse Analysis (CDA).

3.2 PARTICIPATORY ACTION RESEARCH AS RESEARCH METHODOLOGY

Participatory Action Research (PAR) is an approach to research and learning that utilises multiple methods to justify the challenges encountered in a specified society or institution (Nhlapho, 2014:117), because it is participatory in a sense that researchers and co-researchers interact collaboratively, sharing information and exchanging ideas that are meaningful and making decisions, which are striving towards reaching an intended goal. Kemmis and McTaggart (2005:568) concur that PAR is emancipatory in a sense that it helps people discover themselves and to reform into better human beings through others in practical settings and discourses of collaborative engagement and commitment. Utilising PAR as an approach in this study

assisted the researcher and co-researchers to enhance mathematical problem-solving skills for grade 4 learners in solving word sums.

3.2.1 The origin of Participatory Action Research

The originality of PAR is drawn back during the 1940's in Kurt Lewin's work as the first researcher who made sense of its practices and defined it as a process that is implemented in social and democratic settings amongst a group of people whose lives are to be transformed and shaped into something better in a spiral contemplative cycle (Wagaman, 2015:124).These researchers felt that Lewin's work was defined by Kemmis and McTaggart as the foundation of the action research, which suddenly lost its mark due to ideology of the positivist who operated during the first moment called traditional period of qualitative research (Kemmis & McTaggart, 2007:272).

During the 70's, the significance of PAR was noted in Paulo Freire's study where the voiceless groups were given power to voice out their opinions, and those that were marginalised were re-integrated into the mainstream society (Mosia, 2016:83) where they were no longer treated as objects, but as human beings. PAR, in this study was used by co-researchers to assist grade 4 learners in improving their problem-solving skills in solving word sums they struggle to master, using whatever material available at hand (Rogers, 2012:1) to realise the objectives of the study. Since the 1990's, PAR has been regarded as an approach that elevates collaborative attempts to achieve community development and fairness during the entire process of research (Malebese, 2016:88). Through the use of PAR the researcher and co-researchers were able to collaboratively enact solutions to the identified challenges that the grade 4s had faced and the justification of the objectives of the study (Tanner & Seballos, 2010:12; Burns, Harvey & Aragón, 2012:2; Wong, Walker, Wheeler & Wong, 2014:1). The origins of PAR enabled the researcher and co-researchers to employ the multiple theories, multiple perspectives and multiple methodologies of bricolage to enhance the problem-solving skills for grade 4 learners.

3.2.2 Formats of PAR

The formats of PAR entail community-based participatory research, feminist participatory research and mutual inquiry. According to Esau (2015:68), PAR is aimed at bringing about knowledge, skills and values that every member of the society can make use of, in order that their lives change for the better. This succeeded when all stakeholders engaged themselves collaboratively throughout the entire study employing the multiple theories and methods in democratic processes that entail action and reflection in finding solutions (Reason & Bradbury, 2001:1) to enhancing problem-solving skills for grade 4 learners in word sums. Morales (2016:1) is of the idea that PAR was employed not to support only learners, but newly appointed and experienced teachers as well, in improving their teaching skills and nurturing their professional growth.

McDonald (2012:39) described the components of PAR as a process which acknowledged that the problem arose in the community and is explained, analysed and resolved by that community. The components of PAR also anticipated that the active involvement of all stakeholders to the optimal level of the research would advance grade 4 learners' problem-solving skills as they are the primary beneficiaries of the study. Kemmis and McTaggart (2005:568) concur that PAR recognises and anticipates people's wellbeing within the paradigms of social, political and economic contexts, aimed at liberating the oppressed to voice out their ideas and concerns without fear of prejudice and injustices of the past (Blake, 2007:412).

PAR only succeeds in studies where stakeholders with varying expertise plan together, put a plan into action, while keeping an eye on the process and the results of the transformation by looking back at the stages of action (Kemmis & McTaggart, 2005:568). Moreover, PAR is driven by three distinct elements which are, shared ownership of the project, a community-based analysis of social problems and an orientation towards community action (Tshelane, 2013:416), that made a success of the study, which was the enhancement of problem-solving skills for grade 4 learners in word sums. Utilising PAR approaches in this study addressed wider issues of social justice, the marginalised and the lost societies, while on the other hand teamwork and collaboration amongst co-researchers and the researcher were being promoted (Tsotetsi, 2013:141).

3.2.2.1 Community-based Participatory Research

Community-based Participatory Research (CBPR) is a process that collaboratively involves all participants in the research process and acknowledges the standpoints that each participant brings (Minkler, Garcia, Rubin & Wallerstein, 2012:10). They further mentioned that CBPR starts with a research topic, which is an issue to the community members with an intention of integrating knowledge and action for social change to improve the community resources. In this study CBPR was utilised in a manner that has emphasis on collaborative partnerships, established on trust and on theory, as well as practices and policies that would help improve grade 4 learners' problem-solving skills in word sums. Community-based Participatory Research enquires a range of issues that impact the community negatively, such as economic development, health, education, infrastructure and many more with an intention of developing the communities and their struggle for liberation.

Minkler *et al*. (2012:12) concur that amongst other principles of CBPR, are those that emphasise the importance of reciprocal relationship amongst all participants, redressing power imbalances by bringing the marginalized citizens to the more privileged backgrounds by integrating knowledge, skills, values and policies that captivate the concerns of all participants and ensuring notions of rigor, validity and reliability of the research. Mosia (2016:86) reiterates that the principles of CBPR and PAR allowed the team of co-researchers to operate at its highest point. Furthermore, the balancing of research and action was accomplished when research operated as an active process that was utilised to find solutions to daily challenges of teaching word sums.

3.2.2.2 Feminist participatory research

Schurr and Segebart (2012:149) concur that PAR promotes the co-production of knowledge by the academic researcher and local groups in a collaborative research process. Furthermore, PAR seems to merge the goals of feminist fears to change power relations in the research process and to arouse transformative action. According to MacDonald (2012:38) the feminist fields of inquiry enables people to stand up for their rights for participation in society, in order to reduce social immorality through action activity of PAR, as researchers and the marginalised people to join

forces in solidarity to take corporate action for social radical change. Feminist researchers focussed specifically on the role of the feminist discursive community and on forms and topics of research that fostered the liberation of women (Schurr & Segebart, 2012:150), by regarding their capabilities resourceful enough to correct existing models. PAR, from a feminist point of view, contends current academic practices that perceive women as less important societal figures.

Feminist social scientists allow for a critique of mainstream paradigm, contending that social sciences should cater for multiple perspectives about individuals' relation to themselves and also to the community at large (Van Dijk, 2008:86). PAR is educational to all those participating in the research as they engage in a variety of processes through collective interactions (Mahlomaholo, 2009:224). According to Schurr and Segebart (2012:150), feminists focus specifically on the role of the feminist discursive community and on forms and topics of the research that will advance women's freedom. Different approaches to feminism are liberal feminism, postmodern feminism, anti-racist feminism, Marxist feminism, etc. The feminist research discusses the elision of women's experiences, which are regarded less important rather than resourceful enough to correct existing representatives. PAR challenges current academic practices that look down upon women's potential, which was maintained during the modernist phase, the second moment of qualitative research.

3.2.2.3 Community-based approach research

Its focus is based on community organisations that unite members in the community to realise the objectives of the research/study. PAR is an approach that is controlled by members of the community for the purpose of improving and addressing the issue that have been identified and explained by the community in a form of knowledge production, using a variety of methods and theories in lived people's world.

Since PAR is initiated in the community, it requires a lot of interaction amongst all stakeholders in a form of various activities, which involve creativity that will transform the entire process into achieving the designed goal (Hawkins, 2008).

According to Bell and Winn (2000), PAR is a research design that has been a centre of attraction to teachers, because of its practicality and contemplative process that is directed at improving learners' problem-solving skills, especially the grade 4 learners.

PAR was suitable for this study, because it came in handy through the involvement of participants in knowledge production activities of data generation to data analysis in a form of spiral cycle (Greenwood & Levin, 2005; Kemmis & McTaggart, 2005; Mac Naughton & Hughes, 2008).

3.2.3 Principles of Participatory Action Research

Kemmis and McTaggart (2007:281) mention that PAR is capacitating all participants to fully engage themselves, acknowledges the worthiness of all, liberate the oppressed by giving them their freedom and to express their opinions and capabilities that will enhance their problem-solving skills in the lived world. In this study PAR acknowledges the worthiness of co-researchers as the same as that of the researcher in making a success of the study by objectifying their experiences, which was practiced in the second historical moment of qualitative research, known as the modernist phase. McDonald (2012:39), described constituency of PAR as a process which acknowledged that the problem arose in the community and is explained, analysed and resolved in that community.

The second component was acknowledged in the advancement of peoples' lives in the affected community, which is grade 4 learners in this regard, as they are the primary beneficiaries of the study. The third element put its emphasis on the active involvement of all stakeholders to the optimal level of the research. The fourth one embraced a group of voiceless, ill-used, lost and marginalized. The fifth element was acknowledged as that which produced a huge consciousness in the mobilisation of peoples' resources for their development.

3.2.4 Ontology

In this study reality is based on teamwork and co-operation amongst co-researchers working together towards improving the lives of the voiceless (Malebese, 2016:100).

The truth is that human beings do not always see eye-to-eye whenever decisions are to be made; they have to agree on something in order to save the ship from sinking. Employing PAR in the study created the platform for engaging critically in issues that are challenging in an organisation, allowing the participants' freedom to interact openly in pursuit of improving problem-solving skills for grade 4 learners. McTaggart (1997:9) maintains that changes political and social dimension, which means assisting learners improve their problem-solving skills, which they cannot achieve on their own. Co-researchers brought in their indigenous knowledge, using it collaboratively in shaping learners' skills through the systematic research education (Kemmis, 2010:41). The reality of using PAR was examined and manufactured through human involvement and actions that are meaningful.

3.2.5 Epistemology

According to Bondy (2001) and Glanz (2003), PAR is not a method, but an approach that is designed to bring about change and improvement. Reason and Bradbury (2001:1) assert that PAR involves processes that are not autocratic and that allows every participant to be fully engaged by collaborating with others in the research, which means that no single man's input will be taken into consideration. PAR promoted teamwork amongst all co-researchers where everybody was actively involved in the entire process of the research to achieve the intended goal. PAR is emancipatory in a manner that it gives the voice to those who are oppressed and do not have power to stand up for themselves by advocating social justice, freedom and hope (Mahlomaholo, 2009:226). In order for teachers to be effective and efficient in knowledge production, they need to be professionally trained, undergo in-service training and attend workshops regularly. This process is parallel to what takes place in the cyclical stages of PAR (Morales, 2016:157).

3.2.6 Relevance of PAR

The transition from being taught in mother tongue to LoLT in the intermediate phase, affects grade 4 learners, because they first need to adapt to the mathematical language before attempting to solve the word problem. Having not understood the text,

learners would never know what to do with the problem. It was therefore empirical to design a strategy to assist these learners in enhancing their problem-solving skills. Knowledge, skills, values and life experiences of the co-researchers are of valuable contribution to this study. PAR is participatory, because it creates a platform where those who have power become the voice of the voiceless (Mokotjo, 2017:78). PAR is an approach that identifies a problem in the lives of the community members and affords the team members opportunities that come in a range of approaches to find solutions to the problem. The relevance of PAR with the usage of bricolage as the lens that underpins this study, emancipated all the participants to change the lives (Qhosola, 2016:96) of the grade 4 learners by enhancing their problem-solving skills in order to understand and solve word sums. PAR values and regards every participating member, as equals in the study; no member is above the other where PAR is concerned (Mosia, 2016:88). Furthermore, the relevance of PAR was evident in the seventh and eighth moments of qualitative research where all the co-researchers were actively involved in the study, which is totally opposite to what things used to be during positivism, the first and second moments of qualitative research. The fully engagement of all co-researchers ensured the achievement of the objectives of the study. Following, is the cyclical steps involved in PAR.

3.2.7 Steps involved in PAR

According to Walters, Comeau and Restall (2010:13), the processes of PAR begin with the stages where the participating members with a common goal, identify a problem from the group of people in the community, which needs to be solved. The target group were the grade 4 learners in this case, whose problem-solving skills needed to be enhanced, in order to perform better in mathematics. The initial planning stage stated the roles of the team members that were identified earlier on, taking into consideration the expertise, which were beneficial to the research process, and the procedures to be followed when the strategy was being implemented. The implementation stage was done through a series of activities using multiple theories, multiple methods and multiple perspectives of bricolage (Rogers, 2012:5) to keep the ball rolling towards a desired goal. PAR is unique, because participants were regarded as experts, due to their lived experiences, related to the research topics, ensuring that

the relevant issues were being studied (Watters, Comeau & Restall, 2010:13). Furthermore, PAR is a research method involving both participants and researchers through the process from the initial stages to gathering and communicating the final results. Various activities were prepared and implemented by mathematics teachers using available material at hand to make meaning of the text for grade 4 learners' problem-solving skills (Kincheloe & Berry, 2004). Monitoring and evaluation of the process was done collectively, with every member of the team being regarded equally in sharing of ideas and decision-making, and this reflected the success or the limitation of the study. Re-visiting the results only meant that the process of PAR should start afresh or that the objectives of the study were achieved.

Figure 3.1: The Cyclical Stages of PAR

3.2.8 The role of the researcher

Every participating member in PAR has a role to play. Therefore, the role of the researcher was to facilitate the activities taking place in the study, collaborating with the stakeholders who each had inputs that were infused with critical social theories for the purpose of creating pragmatic and viable (feasible-workable) approaches that are just (equitable) (Ozanne & Saactcioglu, 2008:5). The researcher was not viewed as a

super being of the study, but always consulted with the rest of the team members for the optimal result of the study. The researcher created the environment where the relationship amongst herself and the co-researchers was conducive to working together as equals of the study**.**

3.2.8.1 The relationship between the researcher and co-researchers

According to Esau (2015:68), PAR is aimed at bringing about knowledge that every member of the society can access and utilise to the best of their capabilities. This then meant that there should be a sound relationship and mutual understanding between the researcher and co-researchers in making decisions for the effectiveness of the study. Kemmis and McTaggart (2007:282) concur that PAR brings co-researchers together with an aim of exchanging ideas, in order to change peoples' lives by working together as a team with knowledge and skills that enhanced their performance in mathematics, especially in solving word sums they struggle to do. Using whatever available material at hand in all the planned activities, created opportunities for the co-researchers to monitor progress as learners demonstrated their competencies in solving mathematical word sums (DoE, 2009:98).

3.2.9 Rhetoric in PAR

PAR uses a language that is more empowering than demoralising. In PAR co-researchers are treated as equals with the researcher, they are regarded as team members and not mere objects who are to just receive information from the superiors and not to participate actively as others (Malebese, 2016:104). PAR allowed all participating members to voice out their ideas by interactive processes that transformed learners' lives directly and indirectly. PAR promotes democracy, teamwork, co-operation, hope and social justice (McTaggart, 1997:9), which was aimed at identifying, investigating and solving peoples' problems through action research. The researcher, together with co-researchers, planned the activities and how these activities were presented to learners, in order achieve the desired goal. Everyone's who is participating in the research is important, as long as it would help change the lives of the target group, as well as the society at large. Through the

effective and efficient processes of PAR, marginalised citizens are empowered and emancipated (Ozanne & Saatcioglu, 2008:7). PAR advocates that the researched people should be actively involved in the entire study, therefore their inputs matter (Kemmis & Taggart, 2007:281). However, grade 4 learners' mathematical problem-solving skills were enhanced through the engagement of the co-researchers and the researcher in all the activities that were planned for the entire study.

3.3 ETHICAL CONSIDERATIONS

Permission to conduct the study in one of the schools was sought from the Department of Education in KZN. An approval/acceptance was issued by the DoE in KZN. This letter was produced to the School Governing Body as proof that the study to be conducted was legalised and known by the Department of Education personnel. Request was also made to the University of The Free State, because it is the institution where the researcher enrolled in. The researcher explained to the SGB that the nature of the study involved the SGB, the principal, teachers and learners who were the target group. The researcher also informed them that the study would not consume the school's notional times, as it would be conducted after school hours and on weekends. The SGB was informed that no school finances would be utilised as the study progressed. A meeting for requesting parental consent was scheduled and they responded positively. In the meeting, permission for learners to participate in the study was requested from their parents. The nature and the processes of the research were explained and learners' anonymity was assured (Mosia, 2016:92). Consent forms for learners were issued and signed by the parents. Signing of the consent letters did not mean that learners would receive an incentive, but safety. Parents were also notified of withdrawal of their learners anytime they wished so. Teachers who agreed to participate in the study were also informed of the nature and the processes of the study and that they were equally important as the researcher in the study; their ideas would benefit learners, the researcher and other participating beings. T

3.4 RESEARCH SITE PROFILE

The school is located in a rural area in Dannhauser. Most learners live far from school and come from vulnerable families with a challenge of unemployment and poverty. Many of these learners walk barefoot to and from school. This school was chosen because the present researcher is currently employed at, and she wished to uplift the standard of learner performance in word sums. The school is about 20km away from Dannhauser Municipality. This Municipality is under Amajuba District, which is one of the 12 districts in the KwaZulu-Natal province. The school has 764 learners, 401 boys and 363 girls, 22 staff members, one Principal, one Deputy Principal and three Heads of Department. The school also has one administrator, a cleaner, a groundsman and nine members of the School Governing Body. The motto of the school is “Strive in unity”, which emphasises teamwork amongst staff. Every staff member works diligently towards accomplishing the vision and mission of the school.

3.5 DATA GENERATION

This section discussed the research design and the profiling of participants, formation of the co-ordination team, creation of the vision, the plan of action and procedures of data generation. Methods of data generation were centred around everyday experiences of the participants. Generated data were captured in audio and video recordings to be analysed later in the study.

3.6 THE CO-RESEARCHERS

The co-researchers formed a team of two parents representing the SGB, the Principal, Deputy Principal, three HODs for intermediate and senior phases, three mathematics teachers for grades 5, 6 and 7, ten grade 4 learners and a study co-ordinator. The co-ordinating team has roles to play throughout the study. The co-researchers are as important as the researcher herself in the study, as they are all thriving towards achieving the five objectives of the study. Co-researchers are all people that are participating in the study. They all have different roles to play to make sure of the success of the study. Teachers were responsible for imparting the content as per curriculum, because word sums are contained in all content areas in mathematics. Not

only knowledge is taught by teachers in the learning environment, skills and values as well are instilled to shape learners' behaviours. Other participating members were there to observe and facilitate learning. Sharing of ideas during planning and reflection stages is what makes the co-researchers important in the study (Malebese, 2016:106). The partnership the co-researchers form, makes them equal to the researcher, because of the expertise they bring to the study. Without their involvement, the study would not reach its ultimate goal. Learners, being the focus group and the researched, are as important as all other co-researchers (Mokotjo, 2017:83). It is for these reasons that the co-researchers should be treated with respect throughout the study.

3.6.1 Formation of the coordinating team

The coordination team was formed by the participating co-researchers, except for the learners, reason being**,** the learners were underage and could not take part in decision-making processes. Other participating members were the Principal, Deputy Principal, two members of the School Governing Body, three Heads of Department and grades 5, 6, 7 mathematics teachers. A formal meeting took place at the scheduled date and all members were present. Everybody was introduced and composed into a task team responsible for planning, implementing and evaluating all the activities of the study, clearly defining the roles of every participating member in the study. This team would sit in meetings and from time-to-time do re-planning and developing of activities that were not successful, and to monitor progress**.**

3.6.2 Co-ordinator of the study

The co-ordinator of the study is the person who owns the study which is the researcher. Having taught mathematics for quite some time now the researcher realised that grade 4 learners are struggling in solving mathematical word sums. She felt a need of assisting these learners in the transitioning from the foundation phase into the intermediate phase where English is the language for Learning and Teaching (LoLT). The researcher realised that there is a big gap of being taught in the mother tongue in previous grade which is grade 3, to being taught in English in the next grade and thus, these grade 4 learners needed assistance, in order to bridge that gap. As

co-ordinator the researcher requested a meeting with the co-researchers informing them about her intentions of conducting the study on assisting grade 4 learners improve their problem-solving skills in word sums. As co-ordinator the researcher has gained knowledge and skills on how the study should proceed, in order to achieve the intended goal (Kemmis, 2008:129). Another meeting with the parents of participating learners was requested. In this meeting parents were informed about the nature of the study and its benefits. Consent letters for participating learners were issued and signed by parents.

3.6.3 The principal

The principal is the head of the school by the powers vested in him; he manages, guides, develops and supports teachers and learners under his leadership (Qhosola, 2016:116). He is also accountable for every activity taking place within the school. He has parents', learners' and teachers' best interest at heart by making sure that he performs all the duties expected of him in the teaching profession. After selling the idea of wanting to conduct the study, he gave in and extended words of encouragement and gratitude that the researcher came up with a brilliant idea of wanting to walk an extra mile in uplifting the learners' skills, knowledge and competencies beyond the call of duty. He was ensured that the study would not take up school's notional time as it was not a prescribed activity by the Department of Education**.**

3.6.4 The deputy principal

Her duties are almost the same as those of the principal. The co-duties of a deputy principal are those of assisting the principal in the management of the school (DBE, 2016:920). She gives pastoral care to demotivated educators and act as a parent to learners, especially those that participated in the study. As the principal's second in command, she is accountable for all activities taking place within the school in the absence of the principal. As far as the study is concerned, she is meant to monitor the progress of activities and the welfare of learners participating in the study (Malebese, 2016:110).

their expertise was empirical for the enhancement of grade 4 learners' problem-solving skills.

3.6.5 Heads of department

Heads of department are the driving forces of curriculum implementation in the organisation. They support experienced and novice teachers in creating conducive teaching and a learning environment (Qhosola, 2016:135). They were responsible for managing the Learning and Teaching Supporting Material (LTSM) and monitoring progress in all activities of the study. They issued certification to the best achievers for motivational purposes. The HODs also administered disciplinary measures to those who were mischievous during lesson presentation and motivated teachers on punctuality and intervened during conflicts where the researchers did not see eye-to-eye amongst themselves, which could impede the effectiveness of the study.

3.6.6 Teachers

Mathematics teachers for the grades 5, 6 and 7 formed part of the team. There was no particular order in selecting these teachers. Their participation in the study was important for reason that they teach mathematics in their grades, which would be beneficial to grade 4 learners when their mathematical problem-solving skills are enhanced. This would also strengthen their skills, as well as learners' skills in their grades. Mathematics teachers did not interact with learners only, but with parents of learners participating in the study to monitor progress and to share their concerns regarding the implementation of the strategy to assist grade 4 learners improve their problem-solving skills in word sums. They are the ones that have the Subject Content Knowledge and who know techniques to deliver it better than the rest of the team.

3.6.7 Parents

Parental representatives in the study were from the School's Governing Body. Those bodies volunteered to take part in the study, as they wanted to see the end result of the enquiry. Bringing parents into the study was vital in the sense that it created a platform where they could actually see and witness what really happens (Molokomphale & Mhlauli, 2013) during teacher-learner interaction, how teachers

impart knowledge, skills and values to learners, and how learners respond to those interactions. Qhosola (2016:119) supports the idea that parental involvement is the most significant contributing factor towards effective teaching and learning. The role of parents in the study was to promote listening and counting skills, storytelling and using old methods of getting attention from learners. This created a positive learning environment for the young learners and they were so relaxed and actively involved in all activities of the research. Parental involvement made it easy for the teachers to interact with learners and learners' attitudes towards mathematics improved and their learning as well.

3.6.8 Grade 4 learners

The total number of grade 4 learners in this school is 77 but the study comprised 40 learners of 20 girls and 20 boys, ranging from ages 9 to 12 years. These learners were randomly selected without any order of appearance or intellect. These learners came from disadvantaged backgrounds where unemployment and poverty are at their highest peak (Malebese, 2016:108). Grade 4 is the beginner class in the intermediate phase; they are faced with a challenge of transitioning from being taught in the vernacular in the foundation phase to being taught in English in the intermediate phase. Grade 4 learners are also faced with a challenge of having to learn six subjects from being taught four subjects in the foundation phase. These learners were taught mathematics in their mother tongue; however, this means that they had to adapt to being taught mathematics in English. This meant that they first had to conceptualise English as a language before understanding mathematical concepts. These learners' use of the English language had to be promoted by engaging them in conversations with fellow peers, teachers and parents in the team about their learning. These learners interacted openly and freely when they communicated information among themselves, compared to the communication with the teachers and other co-researchers. Seeing their below average performance in word sums, the researcher felt the need to support these learners, hence the study invoked

3.7 INVOLVEMENT OF CO-RESEARCHERS IN THE FORMULATION OF A STRATEGY TO ENHANCE GRADE 4 LEARNERS' PROBLEM-SOLVING SKILLS IN WORD SUMS

3.7.1 Brainstorming

This was a very important session for the study. It created the platform for all the participants to getting to know each other as a team. All members of the team introduced themselves. The significance of this meeting was to give clarity why the study was so important (to benefit learners, not the researcher and co-researchers). The meeting was also to clearly state the roles of the co-researchers and how the activities would be persecuted, timeframes for the completion of those activities and meetings of co-researchers to monitor the progress of the study (Malebese, 2016:114). The session was also about motivating the team to fully engage themselves by bringing innovative methods and approaches that would make a success of the study. The co-researchers were showcased that their involvement in the study was as equally important as the researcher's. Everyone's opinion was taken into consideration, because being part of the research meant that they were of great value in realising the objectives of the study. The team agreed upon creating a vision that would enable the co-researchers to develop the solutions to the challenges faced by grade 4 learners. Having a common vision meant that the team valued one another's opinions in making democratic decisions that impacted the study positively. The SWOT analysis was suggested by the team, in order to give them guidance towards the achievement of the objectives of the study.

3.7.2 SWOT analysis

It is a framework used to identify and analyse the strengths, weaknesses, opportunities and threats that might impact the development of the study. The team used this kind of analysis to determine what strong points they had, weaknesses that needed special attention to work on, as well as what opportunities they could manipulate, in order to curb the threats that might impede the success of the study. The strategic tool was used to evaluate the human resource, participating in the study, methods and resources to be used in order to enhance grade 4 learners' problem-solving skills in word sums.

3.7.2.1 Strengths

Amongst a number of strengths that were identified by the co-researchers were dedication and willpower to co-operate, as well as planning the activities by mathematics teachers before coming to the classroom for lesson presentations. The punctuality of mathematics teachers showed diligence and passion for the subject. Team-teaching was the most integral part of lesson presentation and the creation of a conducive learning environment. Resource materials such as counters/abacuses, charts and other visual representations and manipulatives were available to help teachers in their teaching. The utilisation of these resource materials enhanced the learners' counting skills. Members of the SGB played a part in monitoring learner behaviour during lesson presentations.

3.7.2.2 Weaknesses

Weaknesses are factors that might impact the study negatively if not attended to. The teaching of word sums abstractly was one of the weaknesses that mathematics teachers had and the unavailability of visual representations to some concepts. The Language of Learning and Teaching (LoLT) was a barrier to grade 4 learners, as they were used to be taught mathematics in their home language (Malebese, 2016:117). Teaching methods, such as a teacher-centred approach and rote-learning prevented learners from participating actively in their learning. Learner pace delayed timeframes for completing the prescribed activities. Learners with special needs are usually not catered for when it comes to lesson preparations; this then made it difficult for them to acquire as many skills as possible (Qhosola, 2016:119) for their problem-solving skills in word sums to be enhanced. The principal was not present most of the times, because of the commitments he had, however, he apologised for being not actively involved in the data generation process. A newly appointed grade 5 mathematics teacher had little Subject Content Knowledge, therefore she could not give full support to grade 4 leaners.

3.7.2.3 Opportunities

PAR created opportunities for all co-researchers to actively engage themselves collaboratively and democratically in exchanging ideas with an aim of finding solutions to assist grade 4 leaners (MacDonald, 2012:34). This meant that even the voiceless participants were given the space to voice out their opinions and concerns in enriching the minds of other co-researchers in the study. Being exposed in the learning environment with the rest of the team enabled the parent body the opportunity of learning about the teacher-pupil relationship, which is one of the most important characteristics of effective teaching and learning. Grades 5, 6 and 7 teachers allowed themselves time to prepare and present lessons on word sums to assist grade 4 learners improve their problem-solving skills, which was the main aim of the study.

3.7.2.4 Threats

The SGB felt they were not treated well when the teachers interacted with one another in English. They suffered an inferiority complex, yet they were informed of the objectives of the study. Code-switching was only done when interacting with learners that could not decode the information by themselves. Parents were reminded that the study was about the learners whose problem-solving skills needed to be enhanced, it was about satisfying the learners' needs, to be precise. Parents were put at ease in a very polite and respectable manner though and they adapted gradually as the study progressed. Learners felt intimidated as they were surrounded by too many teachers during their learning, which was something they never experienced before. They were always reluctant whenever they had to answer questions, this then slowed down the pace of the study.

3.7.3 Planning session

During this session the team laid out a plan to put in action the procedures that would be followed when activities were being implemented (Malebese, 2016:119). The aim of this session was to delegate activities to each member of the team, so as to give them time to make thorough preparations for their work. MacDonald (2012:45) states that planning balances ideas presented by co-researchers during the implementation,

monitoring and evaluation of the strategy. This session was significant for the reason that it was empowering to all co-researchers and it would advocate social justice and bring hope in realising the objectives of the study. The team prioritised activities, identified a person responsible for taking that activity through, resources to use, the duration, and the performance indicators for the validity of the action plan. This session was found to be beneficial to co-researchers for the reason that through collaboration all members were exposed to a multiplicity of knowledge and skills (Mosia, 2016:99). Prioritisation of activities meant that they would build on what learners know, from the simple to the complex for consistency. The coordination team prioritised three to five activities for each objective, taking into account the expertise of each participating member.

3.7.3.1 Priority 1: creation of a positive learning environment

This activity was aimed at putting grade 4 learners at ease, as they were exposed to many people around them, which was new to them. In this activity the grade 5 teacher asked the learners to rhyme the body parts as they did in grade R. They collectively started rhyming, touching their heads, shoulders, knees and toes repeatedly. These learners were joined by the mathematics teachers in rhyming the body parts. This activity lasted ten minutes and everybody in the classroom was happy. The grade 5 teacher asked all learners to sit down and started asking questions as all learners were seated. Questions were about the number of body parts a human being has. Learners gave correct answers and they were happy as well. A multitude of skills were developed in this activity, counting skills in particular**.**

3.7.3.2 Priority 2: Introduction of the co-ordinating team to grade 4 leaners

This first activity was about introducing the entire team to the learners. This was done in order to acquaint learners with the people they will be working with throughout the entire study. Learners in this activity were assured that the team was there to assist them with skills they will be able to utilise to solve the word sums in mathematics. This activity was the responsibility of the grade 5 mathematics teacher. She explained the roles of each member to learners. The second activity was done by the grade 4

teacher, as she introduced learners to the team. She ensured the team of their good behaviour in class and that grade 4 learners do enjoy mathematics classroom interactions. The third activity was done by the principal ascertaining learners that mathematics is a powerful tool used to describe the world (DBE, 2003:19), and that the world can and will be a better place with them as agents of change.

3.7.3.3 Priority 3: Importance of lesson preparation, presentation and assessment

This section clarified why lesson preparation was so important during teaching and learning. The activity was carried out by the Head of Department for the senior phase. The emphasis was on the knowledge learners need to be taught, the methods and approaches to be used when instilling that knowledge, what resources to be utilised and when to assess what has been taught. Activity on lesson presentation was done by the Head of Department for the intermediate phase. Emphasis was integrating new knowledge to the existing, taking learners from what they already know towards the unknown in a variety of approaches. The third activity was on assessment and was done by the Deputy Principal. Emphasis was based on the fact that you cannot assess what you did not teach, and that policy clearly defines when and how to assess. She also emphasized the importance of keeping learners' work recorded for monitoring progress. The outcome of assessment determined whether the teacher had to re-teach the topic or to proceed to the next.

3.7.3.4 Phase 1: Lesson presentation

Based on the rhyme learners did earlier on, teacher A presented the first activity by asking learners to count from 0 to 20 in 2s, 4s, 5s and 10s. She then asked learners to tell how many hands they have and how many fingers are in each hand. She asked learners to touch their fingers as they counted them. She then asked how many feet they have, and how many toes each foot has. Thirdly, she asked learners to count the number of desks, windows and everything else in the classroom. This kind of activity was building on what learners know around them before the teacher proceeded to the

complex. Learners were actively involved during the entire lesson, without interruptions by teachers and the parents that were observing the lesson.

3.7.3.5 Phase 2: Lesson facilitation and assessment

During the time teacher A presented her lesson, other teachers recorded learners' responses to questions. According to data collection observations, not all learners got answers correctly. Some learners confused fingers and toes as they did the counting, but the rest got the answers correct. Those that made mistakes were given feedback in a form of chalkboard summary. The main idea in this activity was to instil the counting skills in grade 4 learners and to actively involve learners in their learning to enhance their self–concept.

3.7.3.6 Phase 3: Lesson evaluation

The coordinating team felt that maybe it would help if the teacher had enabled learners to draw their hands and feet on pieces of papers so that they would never confuse the two in future. It was evident that learners could count even though their pace of learning differs. The aim of the lesson was to enhance the counting skills and most learners could count in the intervals mentioned earlier on. Knowing the body parts is learning across the curriculum, integrating life skills with mathematics. Most learners seemed to enjoy the lesson.

3.7.3.7 Activity 1: Lesson presentation

The grade 6 teacher brought counters of different colours into the classroom. She asked learners to sort them according to their colours. She divided learners into two groups of boys and girls. After sorting the counters learners were asked to give the total number of counters altogether. Different answers were given by both groups, because there was a time restriction. The teacher gave learners a second chance to amend their mistakes. This time both groups got the answer correct, but the girls first. A multitude of skills were also developed in this activity, more importantly the counting skill. The girls were very excited of their performance. The teacher then asked the

boys to remove one colour from the rest and asked again how many counters were removed and how many were left. The boys got the first answer correct, but the last one wrong. The girls stepped in and gave the correct answer**.** This activity enabled learners to interact with their peers and also allowed them to work in a calculated time frame. In this activity the teacher was trying to show learners the difference between addition and subtraction, what learners are expected to do when adding and subtracting, because other learners are confused by the keywords “altogether, removed and left”.

3.7.3.8 Activity 2: Lesson presentation 2

A teacher used five containers to put in five chalks of different colours. How many chalks were there altogether? This activity enabled learners with the skill of grouping things, in order to come to the conclusion that grouping is another way of multiplying, which is repetitive addition. This activity also allowed learners the opportunity to develop the division skill. Learners could not deduce that division is an inverse operation of multiplication. The teacher had to spell it out to them to see the difference between the two. The teacher made use of the chocolate slabs, which were shared by four learners equally. She asked learners the total number of slabs of chocolate and how many slabs each learner gets. This activity was about division and it also taught learners about learning to share as a way of living.

3.7.3.9 Activity 3: Assessment of the lesson

Assessment tasks were done to evaluate the learning achievement of learners, in order to strengthen and to enhance the potential of learners in areas of weakness (Malebese, 2016:124). These assessment tasks were a collaborative endeavour by team members, given throughout the activities, in a form of feedback to enhance the teaching and learning action. Learners were pleased with their performance where they did well. Their self-concept was also enhanced, because they could work independently without fear of being ridiculed by others. Their counting skills in presented activities improved, as learners were exposed to as many TLM, such as tangible objects, rather than being taught word sums abstractly.

3.8 DATA ANALYSIS

Generated data were analysed through Critical Discourse Analysis (CDA), which according to Van Dijk (2008:353), is a discipline that analyses spoken and written texts to unveil the discursive source of power, dominance, inequality and prejudice. Furthermore, CDA constitutes society and culture, therefore it primarily studies the attributes of power abuse and injustices, portrayed in social and political settings. According to Bloor and Bloor (2007:20), CDA is a cross discipline that comprises the analysis of text and talk in a wide range of humanities and social sciences. This means that interactions of co-researchers and sharing ideas would be highly considered when data are being analysed. Levels of CDA at which data were analysed are textual, contextual and sociological and it included a collaborative and participatory sequence of activities that empowered and emancipated co-researchers (Blease, 2014:58) to realise the objectives of the study. The study focused on multiple methods and approaches of bricolage model to enhance grade 4 learners' mathematical problem-solving skills in word sums. Tlali (2013:154) affirmed that the levels of CDA are used indirectly in our everyday conversations in our communities, therefore bricolage and CDA used simultaneously, impacted positively in transforming the lives of people, especially the grade 4 learners.

3.9 CONCLUSION

This chapter employed PAR as research methodology in the study. It outlined the background and the originality of PAR, its formats, epistemology, ontology, rhetoric, relationships with co-researchers and the role of the researcher. The roles and responsibilities of all the participants were clearly defined, and procedures and activities were well executed in a variety of methods. The cyclical stages of PAR made it possible for the co-researchers to work together as a team towards achieving the objectives of the study. Data were generated in a variety of activities and were analysed in three levels of CDA, namely textual, contextual and social practices (Malebese, 2016:130). The next chapter presents and discusses what transpired in chapter three when PAR was employed to generate data. The results of utilising PAR in this study was practical, as learners were using concrete objects, which made it

easier for them as they learnt experimentally. It was also theoretical in a sense that operational concepts were learnt concurrently to notice the difference in them, and that the knowledge that was instilled is lifelong. The next chapter discussed the analysis and interpretation of generated data.

CHAPTER 4 :
DATA PRESENTATION, INTERPRETATION, ANALYSIS AND DISCUSSION OF FINDINGS TOWARDS THE STRATEGY TO ENHANCE GRADE 4 LEARNERS' MATHEMATICAL PROBLEM-SOLVING SKILLS IN WORD SUMS

4.1 INTRODUCTION

The study aims at formulating a strategy to enhance mathematics for grade 4 learners' problem-solving skills in word sums. This chapter presents, analyses and interprets data that were generated, in accordance with the objectives of the study. The objectives refer to the challenges facing grade 4 teachers when teaching word sums, and to bring about solutions that addressed the experienced challenges. Furthermore, to understand the conditions under which the strategy was implemented and to anticipate threats that can impede the successful implementation of the strategy with an aim to circumvent them. The final objective suggests evidence for the successful implementation of the strategy to enhance grade 4 learners' problem-solving skills in word sums.

An appropriate discussion on policy-related issues, what the theory entails, and findings from previous research are discussed in the opening paragraph, followed by the extracts from generated data which are analysed at three levels of CDA, namely text, contextual and social practices, which will give it a deeper understanding. Bricolage is the framework that underpins this study.

4.2 THE NEED TO FORMULATE A STRATEGY TO ENHANCE GRADE FOUR LEARNERS' PROBLEM-SOLVING SKILLS IN WORD SUMS

This section investigates the challenges that justify the need to strategize on how grade 4 learners could be assisted in improving their problem-solving skills in word sums. These learners are struggling in solving word sums, as they were taught mathematics in their mother tongue in the previous grade and suddenly the medium of instruction changes to English in the next grade (Phiri, 2014:1), which is challenging

to them. The first thing the team did was to identify the challenges they observed, which are: difficulties in understanding mathematical language, merging mathematical language and English as language of learning and teaching, outdated teaching practices, as well as lack of Pedagogical Content Knowledge to equip teachers with advanced skills to teach word sums to learners.

4.2.1 Challenges in the teaching and learning of word sums

Challenges pertaining to the teaching and learning of word sums are discussed in this section. These are, challenges in understanding mathematical language in the teaching and learning of word sums, strains of integrating mathematical language and English as Language of Learning and Teaching, non-operational teaching practices in the teaching and learning of word sums and lastly, insufficient Pedagogical Content Knowledge in the teaching and learning of word sums.

4.2.1.1 Challenges in understanding mathematical language in the teaching and learning of word sums

Researchers have shown that learners do not do well in word sums, because they fail to conceptualise mathematical language (cf. 2.4.1.1). In addition, Van der Merwe, 2014:27) corroborates that for learners to succeed in solving word sums, they need to have knowledge of language and be able to interpret vocabulary in mathematical terms. In agreement the DoE (2003:5) stated that the teaching and learning of mathematics allow the learner an opportunity to acquire and understand mathematical concepts and make meaning thereof. However, teachers have a responsibility of ensuring that mathematical knowledge, skills and values they impart, serve the needs for learners (DBE, 2003:19). In the constructivism theory learners are allowed opportunities to actively learn and construct new knowledge (Jaleel & Verghis, 2015:1). Engaging grade 4 learners in as many word sums activities as possible, will enable them to acquire the vocabulary they need for their problem-solving skills to be enhanced.

In a grade 4 A class, the team was seated waiting for Mr Gxaba, a grade 7 mathematics teacher to present his lesson. Mr Gxaba presented his lesson as follows.

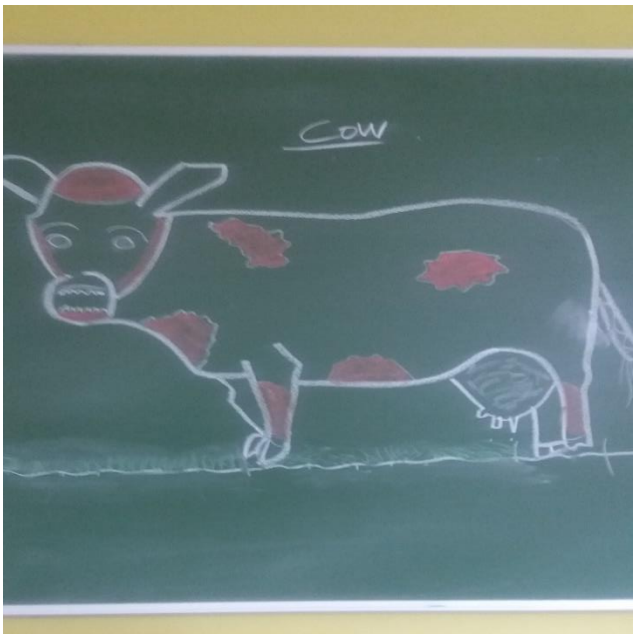
Mr Gxaba*:*

Good afternoon learners

Learners:

Good afternoon, sir

Mr Gxaba drew a picture of a cow on the board



Mr Gxaba (Teacher):

An old man had six cows in his kraal. A kraal is where cows are kept. Can you please tell me how many eyes did these cows have altogether? I want you to answer the questions on the statement I have just made.

For a moment, there was no response from the learners, until one learner raised her hand and said:

Sibusisiwe:

2 eyes.

Mr Gxaba:

Is there anybody with a different answer from Sibusisiwe's?

Lindelani responded without being pointed at and said:

4 eyes.

Philasande (learner):

6 eyes.

Mr Gxaba*:*

Not quite.

Mr Gxaba continued to point at other learners with an aim of getting the answer he was looking for. Learners kept on giving him 7, 8, 9 and 10 answers. Mr Gxaba intervened and gave learners an answer to his question.

Mr Gxaba:

Six cows have 12 eyes my friends. If 1 cow has 2 eyes, it means 6 cows have 12 eyes, this can be written as 2+2+2+2+2+2, which means each cow had 2 eyes. Here is my second question - How many legs do the cows have altogether?

Xolani raised his hand and the teacher gave him permission to announce his answer:

10 legs teacher.

Mr. Gxaba:

What did you do to get to the answer you have given me?

Xolani:

Ngithe 6+4 ngathola u 10

[I said 6+4=10].

Time was over before Mr Gxaba intervened.

During the reflection time, members of the co-ordinating team were seated in the staffroom, reflecting on the lesson Mr. Gxaba presented. Following questions were asked:

Miss Khathi (Teacher):

Mr Gxaba, what concept were you teaching?

Mr Gxaba:

Addition.

Miss Bu (Teacher):

> By the look at learners' responses, I can tell that they did not understand what was required of them. They were just guessing. You also did not indicate whether they were getting answers correctly or wrongly, instead you gave them an answer to the first question. Can you briefly tell us why it happened that way?

Mr Gxaba:

> A lot of answers were given by learners which made me realise that the lesson would take too long before its end. That wanots reason why I decided to give them answers to cut a long story short.

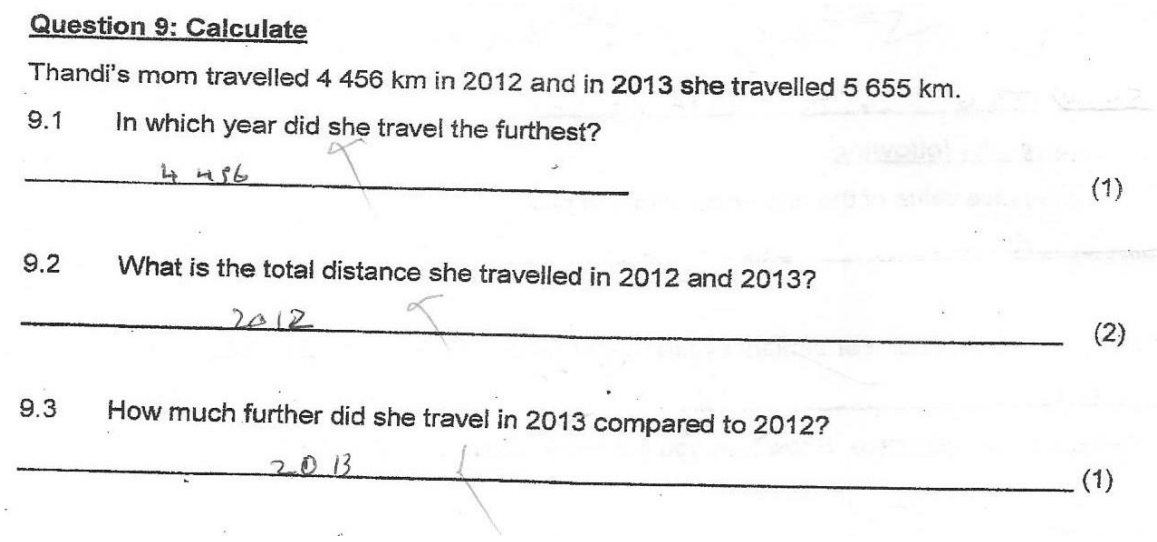
The extracts above indicate that Mr Gxaba did not follow the rule of teaching learners from the known to the unknown, which to the researcher is a contrast of what the policy requires to be done. Mr Gxaba drew a picture of one cow when he actually wanted learners to use that picture for learning addition, instead of drawing or bringing visual representation of six cows to make things easier for grade 4 learners to understand the text much better. Mr Gxaba based his presentation on the assumption that learners knew what they should have said, in order to get the answer correctly, when he in fact did not guide learners with supporting material, which made it difficult for other learners to contemplate on the answers to the questions. Mr Gxaba could have used any material at hand to scaffold his teaching, which is contrast to what bricolage requires (cf. 2.2.7) to enhance grade 4 learners' problem-solving skills in word sums. He also deprived learners of active learning by not letting them draw their own cows. That on its own is against the principles of PAR, hence PAR is participatory (cf. 3.2.3). He could have started from the simple to the complex, in order to accommodate all types of learners in his mathematics class before using a bigger number of cows. This would have been easier for learners to get the answers correctly.

In the researcher's view, Mr Gxaba's questions were based on assumptions, which made it difficult for other learners to contemplate on the answers to the questions. Findings in empirical data are not all in line with literature in chapter two. In conclusion, the challenge facing grade 4 learners could not be addressed to its fullest. To date, grade 4 learners are still struggling to solve mathematical word sums. Following is another challenge to the teaching and learning of word sums.

4.2.1.2 Strains of integrating mathematical language and English as Language of Learning and Teaching in the teaching and learning of word sums

Looking at the learner responses in the first challenge, it is clear that the grade 4s are still struggling solving the word sums. This is supported by Essien (2013:8) when he says teachers are battling to merge mathematical language with English for grade 4 to solve word sums (see section 2.4.1.2). Furthermore, teachers are therefore having a challenge of making the Language of Learning and Teaching easier for grade 4 learners for deep conceptual understanding (DBE, 2012:8). These learners are still in the transition of switching the languages from being taught in their first language to English. However, using English in a mathematics classroom is a prerequisite by the policy, teachers still have a duty and responsibility of instilling knowledge in a way that will benefit learners (Quirk, 2010:10). For learners to be able to tackle the problem, they should first understand the text, which of course is written in English. Having not understood one single word in a text will lead to learners not knowing what to write.

The following are assessments for learners in a grade 4 A class:



Question 9: Calculate

Thandi's mom travelled 4 456 km in 2012 and in 2013 she travelled 5 655 km.

9.1 In which year did she travel the furthest?

4 456 (1)

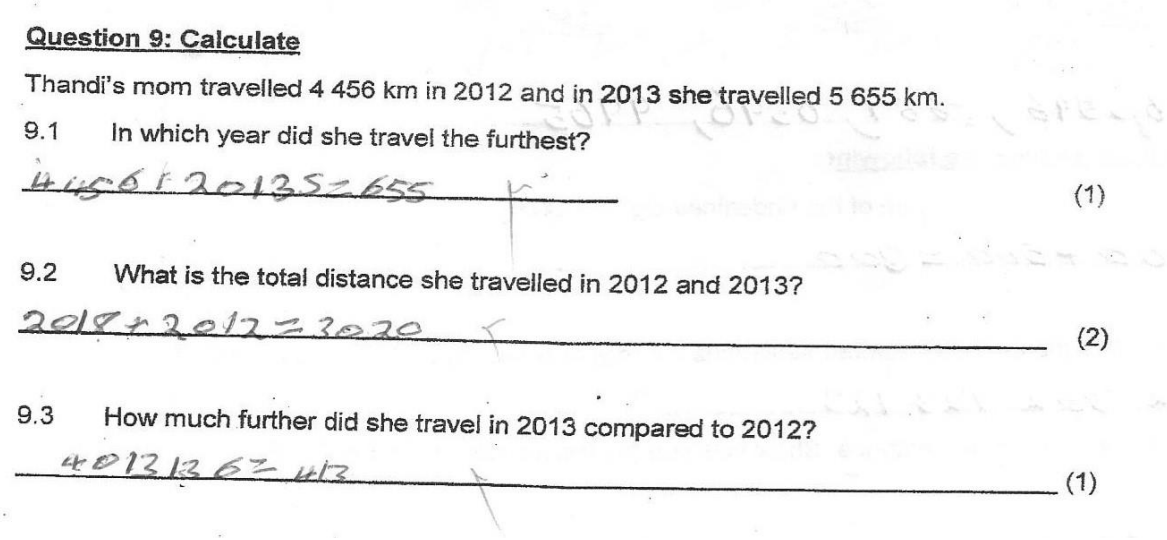
9.2 What is the total distance she travelled in 2012 and 2013?

2012 (2)

9.3 How much further did she travel in 2013 compared to 2012?

2013 (1)

Figure 4.1: Lungisani' assessment on word sums



Question 9: Calculate

Thandi's mom travelled 4 456 km in 2012 and in 2013 she travelled 5 655 km.

9.1 In which year did she travel the furthest?

4456 + 2013 = 655 (1)

9.2 What is the total distance she travelled in 2012 and 2013?

2018 + 2012 = 3020 (2)

9.3 How much further did she travel in 2013 compared to 2012?

4013 13 6 = 413 (1)

Figure 4.2: Philasande's work of assessment in solving word sums

Looking at the above assessment for grade 4 learners, they all got the answers wrong. The answers they gave showed that they did not know what to do to get the answers correct. They did not differentiate between distance in kilometres (KM) and the years given in a statement. It appears that learners have difficulties in integrating mathematical language and English in making sense of the meaning in the given text.

Mr Mkhabela:

> *Uke wawufundisa umsebenzi onjengalona ngaphambilini, Mnumzane? Okungenza ngibuze ukuthi kubukeka ngathi abafundi bayaqala ngqa ukubona umsebebenzi onjena.*
>
> [Have you taught the content of this nature anytime this year? The reason I'm asking is that, to me it feels like all the learners are seeing this for the first time.]

Mr Yende:

> *This is the last term of the year, addition and subtraction are covered in every term. By now learners should be able to do calculations on addition and subtraction.*

Mrs Khathi:

> *Mhlambe besizobona okuhlukile kunalokhu ukube bekungezona izibalo zengxoxo. Kusho ukuthi izibalo zengxoxo ziyabadida abafundi kunezibalo ezizimele nje ezingenangxoxo?*

> [Perhaps we could have seen something different from this had it not been the word sums? But simple addition and subtraction. It means that word sums are confusing to learners.]

Mr Mkhabela*:*

> *Learner responses indicate that more examples of word sums should be taught to grade four learners until the majority get the idea quite clearly.*

Based on the above extracts, it is clear that grade 4 learners are still struggling with word sums. This understanding is in line with the discussion on merging mathematical language and LoLt in section 2.4.1.2., which again is observed in this analysis of chapter 4. It is clear that teachers have a responsibility of merging mathematical language and Language of Learning and Teaching, in order to enhance grade 4 learners' problem-solving skills in solving word sums that they struggle to solve. There are English words that learners needed to understand and merge with mathematical language, in order to solve the problem. These words are travelled and furthest. Employing multiple methodologies, multiple theories and multiple perspectives of bricolage will assist teachers in their endeavour to enhance problem-solving skills for grade 4 learners. The first moment of qualitative research, which is the tradition period will also assist teachers in enhancing grade 4 learners' problem-solving skills in solving word sums, but also in solving problems they encounter in real life situations. Quirk (2010:16) attested that word sums are also best suitable for unifying the mathematical learning with the lived world. Employing the multiplicity of bricolage and PAR in this study assisted the co-researchers to use team-teaching strategies, because PAR is participatory (cf. 3.2.3). The infusion of PAR and bricolage by the co-researchers will enhance grade 4 learners' problem-solving skills in word sums, because a collective effort produces better results than an individual one. There is co-relation between empirical data and what the literature review presented. However, there is still a lot to be done by the teachers in the teaching and learning of word sums, as grade 4 learners are still struggling with solving word sums.

4.2.1.3 Challenges of non-operational teaching practices in the teaching and learning of word sums

Non-operational teaching practices are those practices that have little or no value at all towards the learning of learners. Such examples are those that do not exempt learner's platform to actively involved in their learning. They only promote learners to be passive receivers of knowledge. The manner in which teachers impart knowledge to learners impacts either positively or negatively to their learning. As agents of change, teachers are reliable sources of information and are trusted by parents and learners as well. Of all the resources that are useful in a child's learning, teachers are the most significant ones, because they are the ones to instil knowledge, skills, values and attitudes to learners, fulfilling the seven roles teachers are expected to fulfil in order to be competent (Harley, Barasa, Bertram, Mattson & Pillay, 2000:287). As designers of Annual Teaching Plans, they should cater for the needs of all learners they teach. Furthermore, they decide on the teaching and learning material they are going to use when teaching different concepts, different methods and the assessment techniques they will use upon assessing learners' work. According to the DBE (2012:4), teachers are provided with the curriculum that prepares learners into acquiring as much knowledge and skills that they will be able to utilise in their lived world, as well as across the globe.

The South African Curriculum is guided by the principles under which it is implemented. Teachers are refrained from using the old methods and approaches of teaching when implementing the curriculum. Such methods are rote learning, teacher-centred approach, uncritical approach and many more. These approaches are too old and outdated with little or no effect in children's learning. In addition, these approaches were used during the traditional period of positivism where learners were passive receivers of knowledge (Denzin & Lincoln, 2008).

In a grade 4B class, the research team was seated patiently waiting for Mr Yende to present his lesson:

Mr Yende (teacher):

> *Good afternoon, learners.*

Learners:

Good afternoon, sir

Mr Yende:

> *Learners, today's lesson is on multiplication. You will multiply the two given numbers in order to get the third one, which will be your answer.*

Mr Yende:

> *Solve the following problems:*

Mrs Nkosi puts 3 sugars in a cup of tea. How many sugars will she put in 6 cups of tea?

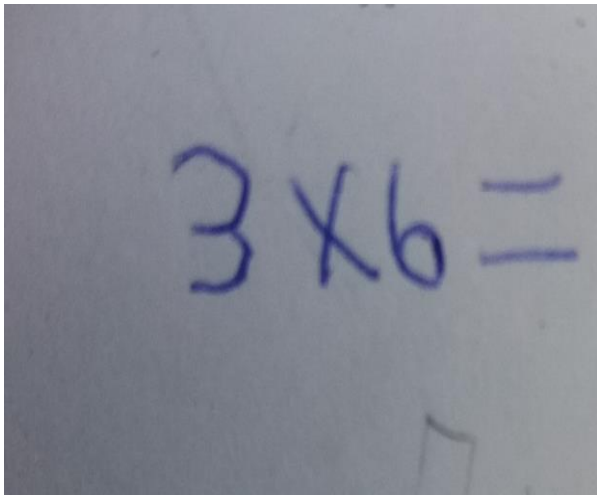


Figure 4.3: Sipho's response on a word sum

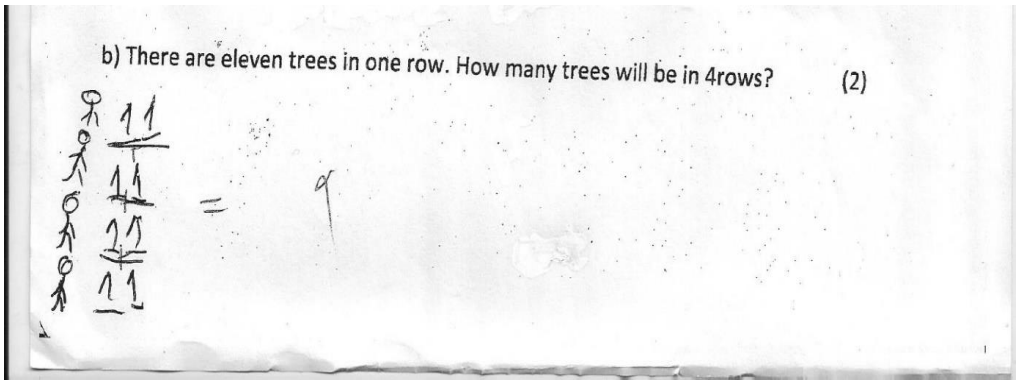


Figure 4.4: Cebos' work during assessment

The research team met at the staffroom after the lesson ended for discussion. Discussion was about Mr Yende's lesson.

Miss Khathi (HOD)*:*

> *Do you think telling learners what they will be learning is the way to go about it, sir? Don't you think you deprived learners' freedom to express their feelings and decide themselves what meaning they will deduce from reading the text?*

Mr Yende (Teacher):

> *Lezingane zibhala kancane kakhulu ziphuze ukuqeda ukubhala kanti nesikhathi esiningi siyamosheka.*
>
> [These learners take too long to complete the activities. I am trying to speed up the process because time is not on our side.]

Miss Saliva*:*

> *Ucabanga ukuthi ukubatshela uphawu okumele balusebenzise kufanele yini kunokuthi bazitholele bona ngokwabo? akuyona indlela efanele leyo mnumzane Yende. Uzobatshela yini noma sebebhala izivivinyo zabo?*
>
> [Do you think telling them the operation to use is best for the learners? Can't you let learners decide which operation they should use. The way they understand the text? Will you be telling them what to do even during exams?]

Mr Yende*:*

> *I did not want them to get confused when choosing which operation best suited the texts.*

Looking at the extracts above, Mr Yende was telling learners what the lesson is all about. He was also telling them what they should do to get at the answer. There is no policy document that supports what Mr Yende is saying. Instead of allowing learners to construct their own meaning out of the texts, and give them their freedom to think critically and to apply the knowledge they have, he told them what to do (Malebese, 2016:136). He did not create an environment where learners can explore their learning and make mistakes so they could learn from them. Mr Yende was using the old method of teaching where the teacher dominates and overpowers learners, instead of allowing them to share ideas and own their learning through active learning. Mr Yende could have scaffolded learning by letting learners engage in classroom discussions, which are learner-centred and constructive, rather than dictating what learners should do to get to the answer (Silliman & Wilkinson, 2007:301). He did not follow the principles of

PAR, as democratic and liberating (cf. 3.2.3). Instead of giving learners their freedom to construct their meaning of the text, he overpowered them, closing the platform to explore their options. He came into the classroom unprepared and did not seek assistance from other co-researchers on how he could present his lesson on multiplication. He did not bring any material at learners' disposal to make his lesson easier to the learners to tackle than to be told how to get to the answers. Mr Yende did not make use of various approaches, theories and methods of bricolage to his teaching (Mahlomaholo, 2013:387) to make his lesson more meaningful and easier to learners. However, literature and empirical data informed each other, hence, word sums are still difficult for grade 4 learners to master. This led to the next challenge in the teaching and learning of word sums.

4.2.1.4 Insufficient Pedagogical Content Knowledge in the teaching and learning of word sums

Johnstone and Chapman (2009:139) attested that lack of teacher training facilities has a negative impact on learner performances, because learners end up being taught by teachers without Pedagogical Content Knowledge. This becomes a problem, because a teacher who did not undergo proper training on how to teach learners at different cognitive levels of understanding will never know which methods and approaches to apply when they engage with learners. Another factor of learners performing badly in mathematics is curriculum change, which is influenced by political agendas (Mishra & Koehler, 2006:1027). The DBE (2012:8) states that the teaching and learning of mathematics aimed at developing specific knowledge and skills, which teachers and learners used in solving social and mathematical problems. Mathematics teachers should have a conceptual understanding of mathematics, which influenced classroom interaction in a positive way (Turnuklu & Yesildere, 2007:1). However, teachers need to undergo teacher-training programs that provides them with Pedagogical Content Knowledge, in order to equip learners with the skills they need to solve mathematical problems. Teachers without or with little PCK encounter difficulties in assisting learners, because they lack pedagogy of knowledge and also need assistance themselves with teaching and assessment strategies that enable them to enhance learners problem-solving skills. Tanisli and Kose (2013:2) and An, Kulm and WU

(2004) concurred that PCK comprises of knowledge of content, knowledge of curriculum and methods of teaching. Researchers have revealed that teachers with PCK and MCK know what knowledge and skills learners need for their problem-solving skills to be enhanced (Kahan, Cooper & Bethea, 2003:223).

The following lesson was presented by Miss Saliva:

Miss Saliva (Teacher)*:*

> *Open your workbooks on page 50 and do that activity.*

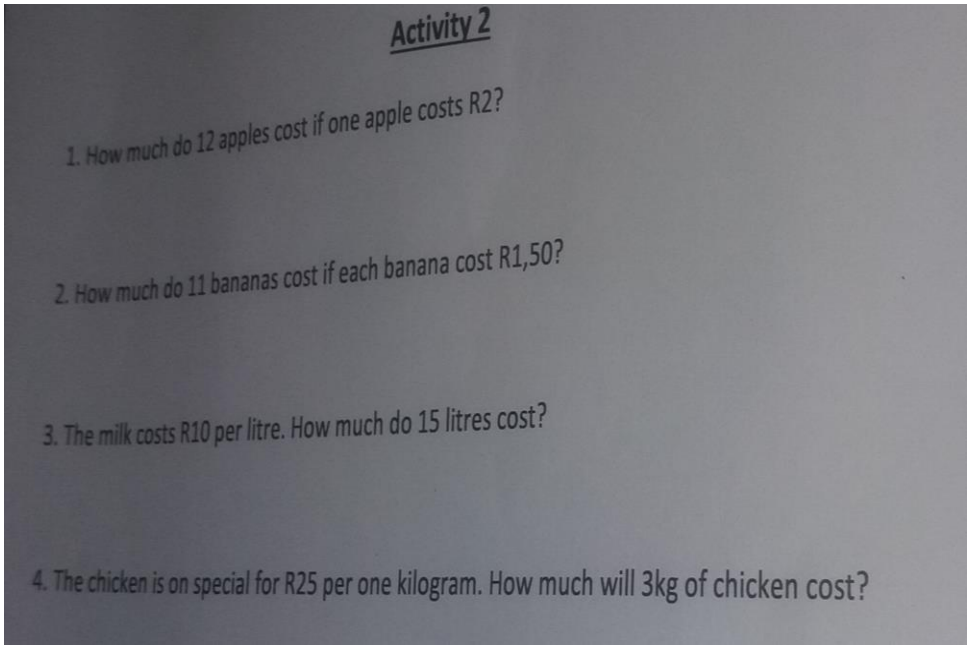


Figure 4.5: Showing an activity extracted from learner workbooks

Looking at the activity learners were about to do the research team raised the following concerns:

Mr Snake (Teacher):

> *I don't understand the fact that my colleague asks learners to do an activity having not first demonstrated how to go about doing it. Does a teacher not set an example for learners to follow on?*

Miss Khathi (HOD):

> *Yes, even baby animals, they follow on parents' footsteps, just imagine a young crab deciding to walk straight, which is opposite to that of parents. (That was a joke colleagues).*

Miss Saliva (Teacher)*:*

> *I thought telling learners what to do is one way of doing it right. Our teachers used to tell us what will happen during teaching and learning. I anticipated that even the old methods of teaching can still work even nowadays. I wanted to see if learners would be able to count on their own before I would assist them.*

Mrs Deyi (Deputy principal):

> *I think we need to be innovative when planning activities for learners, so that they will interact with the peers and share ideas by constructing meaning on given texts. Telling learners what they should do does not give them a space to grow. Grade 4 learners need to be shown the way of doing things first before they attempt on doing the activity.*

Looking at the excerpts above, the teacher had good intentions wanting to know how much learners know, but failed to cater for all learner types. Miss Saliva's presentation was based on the assumption that learners already know how to do multiplication. Times have changed, maybe the method used worked for the teachers during the positivism period where teachers just told learners what they should do. Literature states that learning is cumulative (Fox, 2013:4), which is completely opposite to what the teacher did. Learners were assessed on content they were not taught which is contradictory to what policy entails. According to (DBE, 2012:293), assessment is a process that entails the collection of evidence of learners' achievement that was instilled as knowledge and skills during teaching and learning. In the researcher's opinion the teacher lacked Pedagogical Content Knowledge, because her teaching was based on assumptions. She assumed that all learners know how multiplication is done and failed to apply inclusivity in her lesson presentation. Grade 4 learners are adapting from being taught in their mother tongue to English, familiarising them with the mathematical terms and content first before assessing them would be the best practice the teacher could have done. Learners could have been arranged to sit in

groups so as to prepare them to sharing and exchanging ideas to promote cooperative learning and peer-tutoring (Malebese, 2016:137) in mathematics classrooms.

4.2.2 Summary

For teachers to be proficient in teaching mathematics, they should have Pedagogical Content Knowledge to be able to impart mathematical knowledge. They should use the multiplicity of bricolage, which entails the multiple theories, multiple perspectives and multiple methods (Kincheloe, 2008:323) in their teaching to make it easy for the learners to grasp the content presented to them. Participatory Action Research was not evident in most of the lessons presented in this section. Thorough lesson presentations were not evident, which is a sign that team work was lacking from the co-researchers. The application of TLM was also missing in most activities that were planned by co-researchers. All the above challenges impacted negatively in the teaching and learning of word sums for the grade 4 learners. The following section will discuss the solutions to the challenges grade 4 learners' experience when they are taught word sums in a mathematics classroom.

4.3 COMPONENTS OF THE SOLUTION TO FORMULATING A STRATEGY TO IDENTIFIED CHALLENGES IN THE TEACHING OF WORD SUMS IN A GRADE FOUR CLASS

This section discusses solutions to the problems that were identified in section 4.2, which are consolidating mathematical language and vernacular languages, fostering learners' mathematical language in the learning of word sums, using advanced teaching practices in the teaching in mathematics settings and utilisation of visual representation in the teaching and learning of word sums.

4.3.1 Consolidating mathematical language and vernacular languages in the teaching of word sums

According to Hastuti (2017:5), consolidating mathematical language and vernacular languages is a strategy to communication that is usually found in first and second

language contexts teachers and learners use from the less privileged South African schools. However, learners' language is used to scaffold learning (Vygotsky) in order to assist learners to communicate easily with teachers and to understand the content better (Setati & Adler, 2000; Adler, 2001; Ncedo, Peires & Morar, 2002; Setati & Barwell, 2004; Mathye & Setati, 2006; Setati, 2001, 2003b, 2003c, 2005, 2006, 2007). Consolidating mathematical language and vernacular languages in mathematics classrooms enhances learners' problem-solving skills in word sums and the entire performance in mathematics increases. Teachers are allowed to divert to learners' communicating language where learners fail to understand the instructions, therefore using learners' first language in guiding them towards better understanding is not an offence. Learners perform better when the instruction is clarified in their mother tongue, as this gives them an opportunity to own their learning and allows them freedom to apply the knowledge they learnt (cf. 2.4.2.2).

Following are samples of learner scripts after the teacher diverted to mother tongue:

Miss Bu:

> *Abantwana abawu 4 bahlukaniselana ushokoledi ongamaqebelengwana ayishumi nesithupha. Umntwana ngamunye uzothola amangaki amaqebelengwana?*
>
> [16 slabs of chocolate are to be shared by 4 learners. How many slabs will each learner get?]

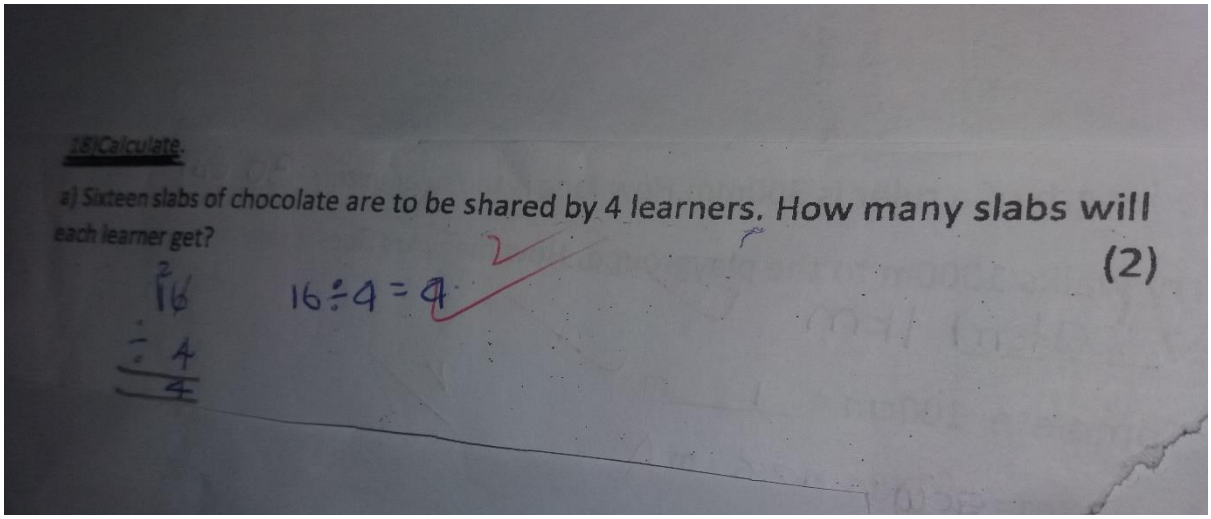


Figure 4.6: Zama's work after the teacher diverted to learners' vernacular

Miss Bu:

USphesihle uqoqe amabhodlela awu-65 ukuze ahaywe. Umngani wakhe uNdabezinhle waqoqa aphindekeka-10 kulawa kaSphe. Mangaki ke amabhodlelaaqoqwe umngani?

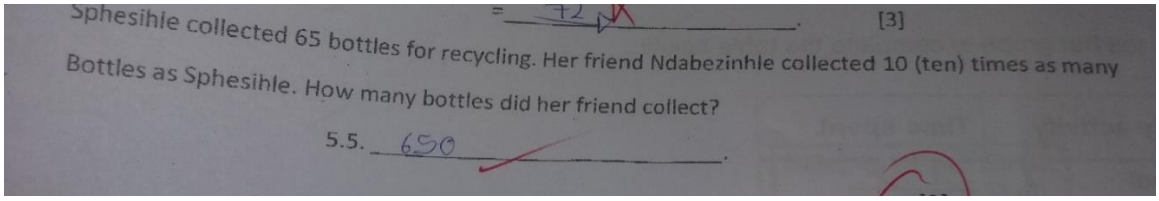


Figure 4.7: Lethiwe's work after the teacher consolidated mathematical language and vernacular languages

Miss Bu:

Umama kaThandi wajikeleza amakhilomitha awu 4456 ngonyaka ka 2012 kanti ngo2013 wajikeleza amakhilomitha awu 5655. Yimuphi unyaka ahamba ngawo kakhulu kunomunye?

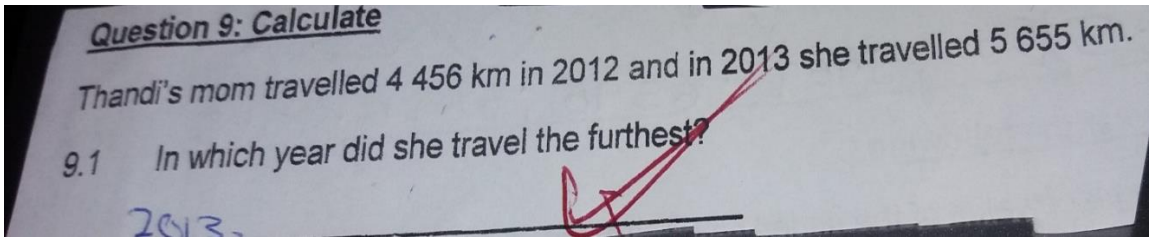


Figure 4.8: Sam's work after the teacher diverted to learners' mother tongue

During discussions, teachers made the following comments:

Mr Snake:

Learners understand better when certain concepts are explained in mother tongue. At first learners did not understand what was expected of them.

Miss Snake:

Before the teacher diverted to learners' vernacular language, they just wrote what came to their minds without understanding what the sum required them to do. Now that everything is clearer, they know exactly what to make sense of the text.

The excerpts above are an indication that learners get to understand the meaning of the text once it is translated to their mother tongue, before they are able to do the sum correctly. They gain confidence and start owning their work as they tackle the problem.

An interpretive bricoleur made things easier for grade 4 learners by interpreting the text in a way that was understood by learners, after their mother tongue was used. Evidence has shown that integrating mathematics and vernacular languages is a solution to a problem where learners do not understand the LoLT. There was no evidence regarding the inclusion of PAR being critical (cf. 3.2.3) before the teacher explained the text in the learners' mother tongue, until his intervention. Researchers have revealed that learner performance improved in schools where teachers diverted to learners' mother tongue in the teaching and learning of word sums. Lastly, evidence in empirical data is in line with the literature. Next is the discussion on fostering learners' mathematical language in the teaching and learning of word sums.

4.3.2 Fostering learners' mathematical language in mathematics classrooms

Learners' mathematical thinking needs to be developed with the necessary skills that assist them in their problem-solving skills (Bicer, 2013:1). The DoE (2011:43) stipulates that teachers can use a range of techniques to enhance learners' problem-solving skills in mathematics, to make things easier for learners. Such examples are using of number sentences in word sums, building up and breaking down of numbers, using of commutative and associative properties of whole numbers, solving of problems in contexts and context-free calculations. To nurture learners' mathematical thinking, keywords should be explained to them, which will guide them in their endeavour to attempt the problem. Grade 4 learners should be told that the sum is the answer one gets when adding numbers, so that they will be able to solve mathematical problems. Grade 4 learners should be told that the difference is the answer one gets when subtracting numbers so they will be able to put the correct sign in solving a problem. e.g. 7 **ducks** swim in the **pond.** 2 ducks come out of the pond. How many ducks are left inside the pond? Learners cannot do these calculations in word sums without the teacher's assistance. It is therefore the duty of teachers to equip learners with knowledge, skills and values necessary to nurture their level of thinking for growth in solving the word sums.

Grade 4 learners need to understand words used in a text e.g. duck and pond first, before working on the problem. Learners learn better when they associate things. (cf. 2.4.2.1). Once learners have acquired as much vocabulary as possible, they will not

encounter problems in constructing their own meaning in a given text in solving mathematical word sums. Through Constructivism theory by Piaget, teachers can assist learners to construct new knowledge from the prior knowledge they have in order to solve word sums. Following is the lesson presented by Miss Saliva while the research team was seated in grade 4A classroom.

Miss Saliva: 1.

It took 25 minutes to drive to Dannhauser by car and 55 minutes by bus from school. Which mode of transport between a bus and a car is faster?

Learners (in unison)*:*

Car!

Miss Saliva:

Which transport took too long to arrive in Dannhauser? Hands up.

Thando:

A bus took too long.

Mr Saliva*:*

Good, Thando. Learners, please do the following calculations.

1) *Find the difference in minutes between the time taken by car and by bus to Dannhauser?*
2) *There are 32 girls and 57 boys in grade 4. How many learners are there altogether?*

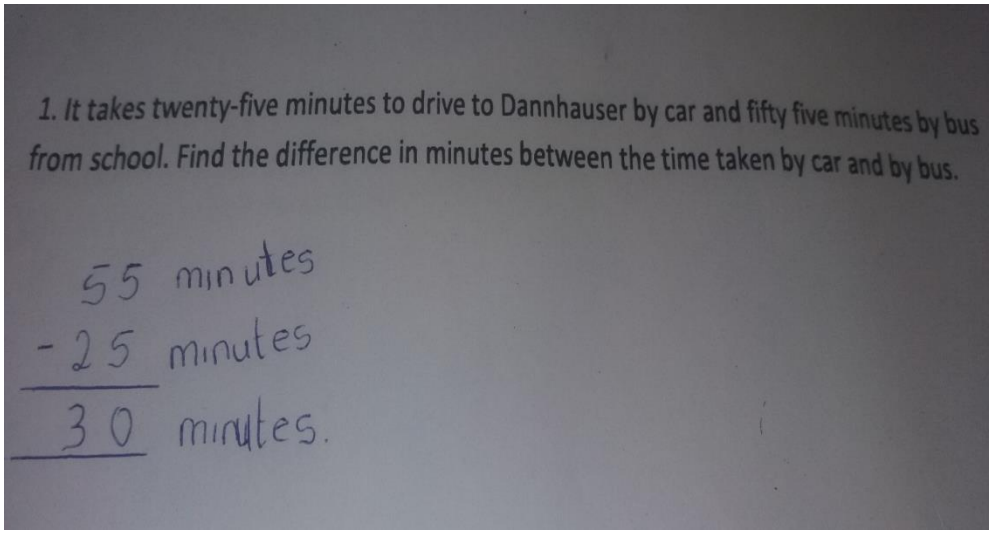


Figure 4.9: Thando's work showing understanding of the text

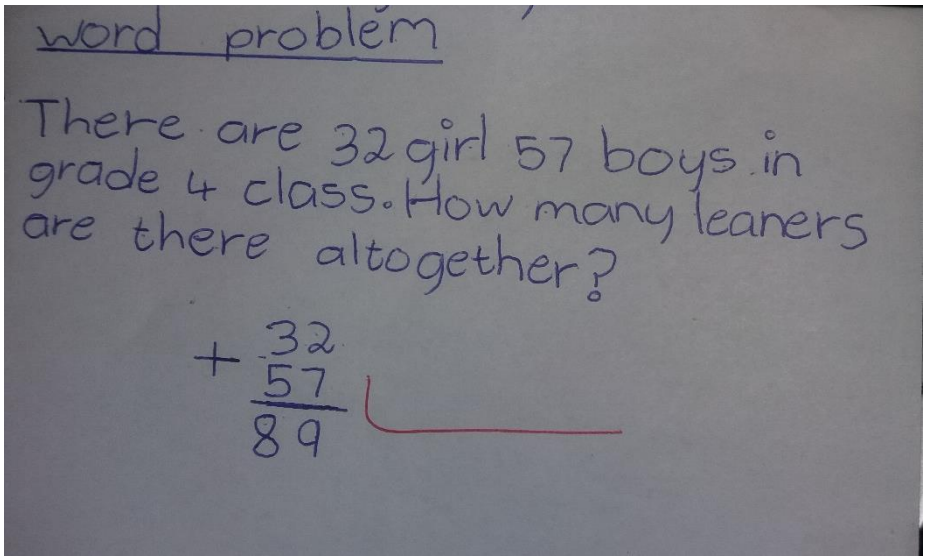


Figure 4.10: Ntando' assessment showing successful understanding of the concept

In grade 4b class, the research team was gathered to reflect on Miss Saliva's presentation and learner assessments:

Miss Bu:

> *In my view, Miss Saliva' s presentation was clear and not ambiguous because learners gave correct answers. Looking at the learner assessments, I can tell that these learners have mastered the concepts well.*

Miss Khathi:

> *I agree, learners did not guess the answers, like it happens when the questions are not clear enough. I like the way they did in their assessments. It shows that their understanding of addition and subtraction in word sums is clearer.*

Based on the above evidence, it seems Miss Khathi' s lesson was easy to follow. Looking at the answers given by the learners, it is clear that the teacher took into consideration learners' prior knowledge and built from it. They did not encounter problems in answering all the questions the teacher asked. In addition, learners were confident in responding to the questions and showed that they knew their story. The principles of PAR were evident in Miss Khathi' s lesson presentation and it was in line with those of bricolage. Its multiplicity in theories, perspectives and even methodology

was also evident. Furthermore, the empirical data is in line with what literature reviewed in chapter two. Following is a discussion on advanced and innovative teaching practices in the teaching and learning of word sums.

4.3.3 Advanced teaching practices in the teaching and learning of word sums

Blease (2014:33) asserts that writing is the most influential and significant tool in the teaching of mathematics because the more learners write, the more skills they acquire to use when solving word sums. Bicer, Capraro and Capraro (2013:363) in their work concur that writing gives learners a platform to infuse what they have learnt into what they already know in writing to check the effectiveness of teaching styles and approaches used by teachers during teaching and learning (cf. 2.4.2.3). Through writing, learners can always go back to their work and mend mistakes and errors caused during the writing process. Activities that are written down help learners for future referral, i.e., learners use their workbooks and journals for revision purposes during assessments. Teachers will not be able to see where learners are lacking and give feedback if learners do not engage themselves in writing practices. Gibson (2008:333) attests that through writing learners get an opportunity to edit their work before forwarding it to the teachers for marking. According to the DBE (2011:94), learners should do both oral and written work in mathematics to monitor learner progress to enhance problem-solving skills for grade 4 learners in word sums. However, theory in mathematics classrooms does not work when taught alone, but it informs practical examples for deep conceptual understanding. In order to master these concepts, learners need to engage themselves in so many writing activities as possible, because mathematics cannot be taught abstractly. However, keeping of journals and workbooks for written activities in a mathematics classroom benefits both teachers and learners.

In a grade 4B class, the research team was wating for Mr Yende who presented his lesson as follows:

Mr Yende:

> *Good day, learners.*

Learners:

Good day, sir

Mr Yende:

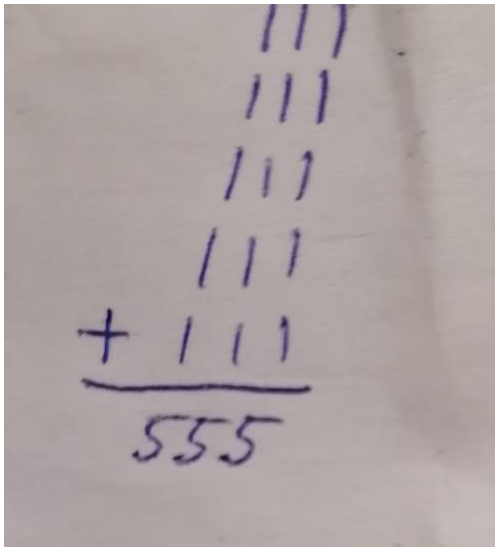
A street vender bought 5 packets of sweets from the shop. Each packet had 111 sweets in it. How many sweets were in all the five packets? First tell me how many sweets were in one packet?

Learners:

One hundred and eleven (111).

Mr Yende:

Good. We want to find out the number of sweets in 5 packets. Can you solve this problem for me learners'?



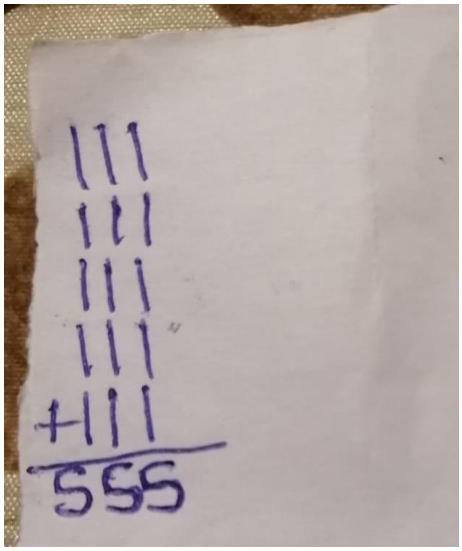


Figure 4.11: Learners' responses to the problem

Mr Yende:

You did get it right but we can also do it this way, 111 × 5 = (100+10+ 1) ×5 =555

(100 × 5) + (10 × 5) + (1 × 5)

=500 + 50 + 5

=555

Mr Yende did the above activity together with the learners and later asked learners to refer to his example in order to do the activity on their own. He gave the following sum for learners to do:

There are 5 desks in one row. How many desks will be in 7 rows?

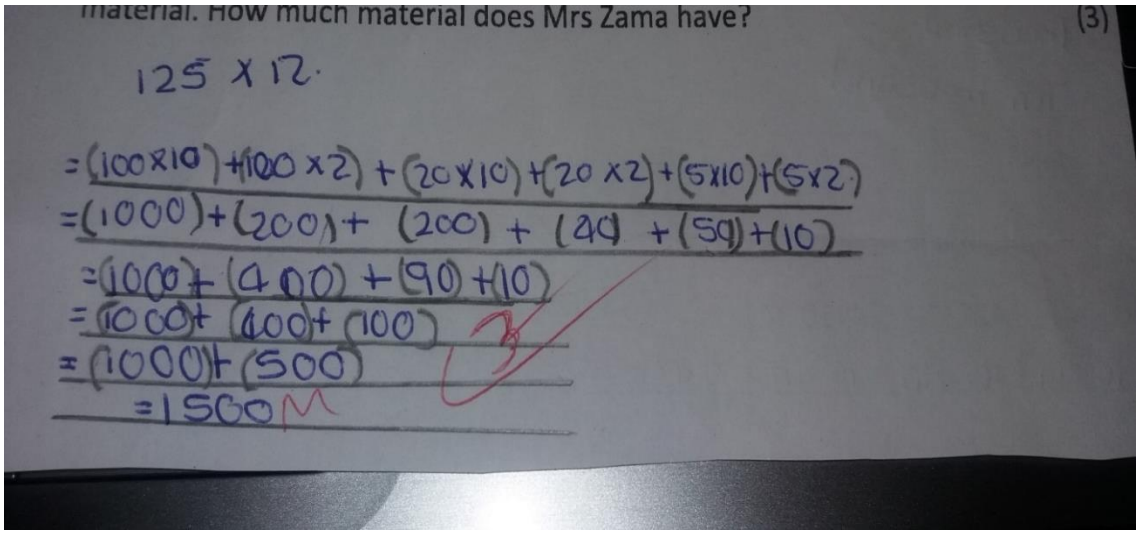


Figure 4.12: Thando's assessment on problem-solving

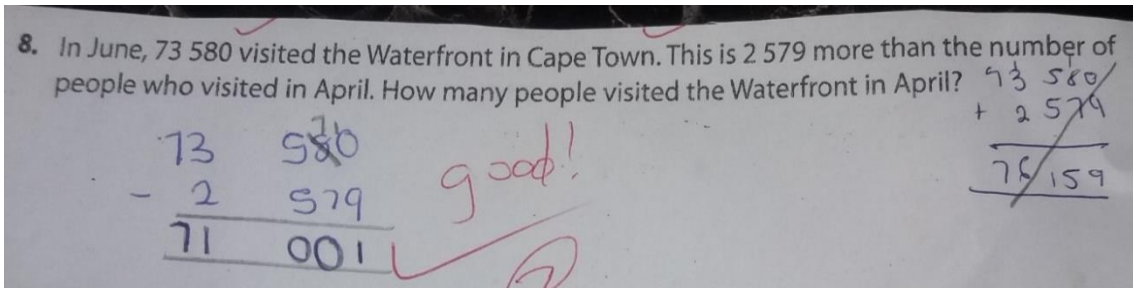


Figure 4.13: Sam's assessment indicating that he understood the concept

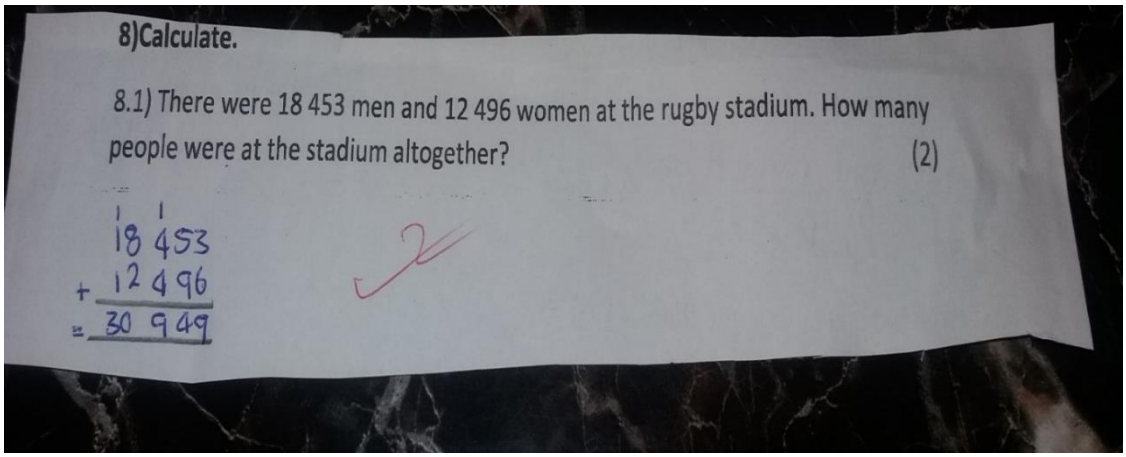


Figure 4.14: Philasande's assessment after he mastered the concept

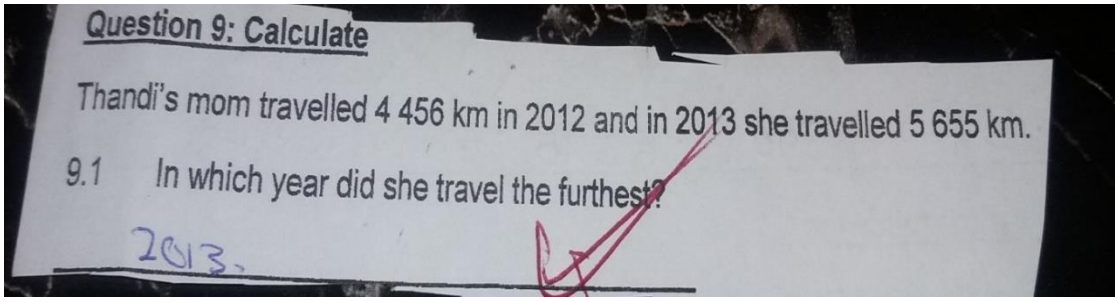


Figure 4.15: Lerato's work showing that she had a better understanding of the concept

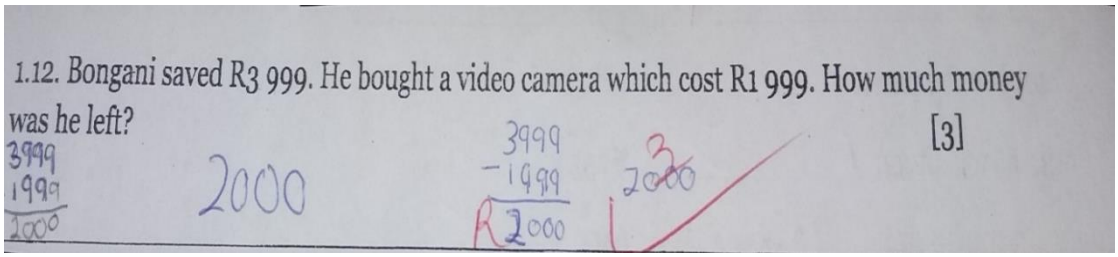


Figure 4.16: Monde's work showing that he can count even when he does not put everything needed

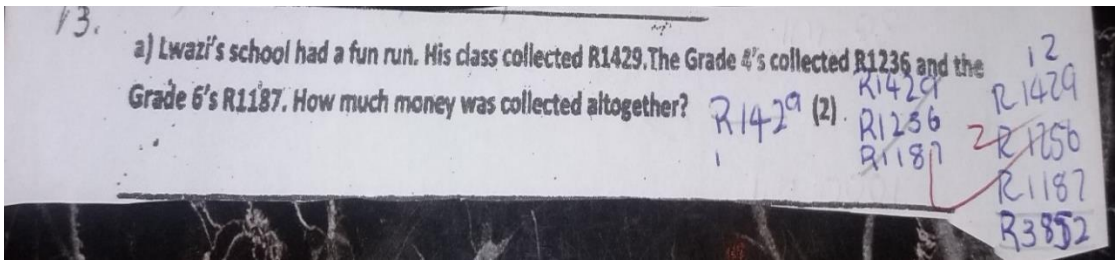


Figure 4.17: Nombuso' work after mastering the concept

Above are learners' responses after they had inferred from Mr Yende's examples.

These samples are an indication that the more learners are given the opportunity to write word sums, the more their potential develops and their problem-solving skills are enhanced. Mr Yende, a bricoleur that wanted the best quality of knowledge for his learners, engaged learners in a variety of activities that assisted in uncovering new insights of knowledge production in word sums (Kincheloe, 2008:19).

During the reflection time, the team applauded Mr Yende for involving learners during lesson presentation so that they could learn in as many ways of approaching the problem as possible:

Miss Saliva:

I liked the way you engaged learners in your presentation as you guided them with questions with an aim of developing their potential in solving word sums.

Miss Snake:

I agree, practice makes perfect. The more learners are exposed to writing practices, the more they will gain deeper insight on problem-solving strategies that will enhance their problem-solving skills.

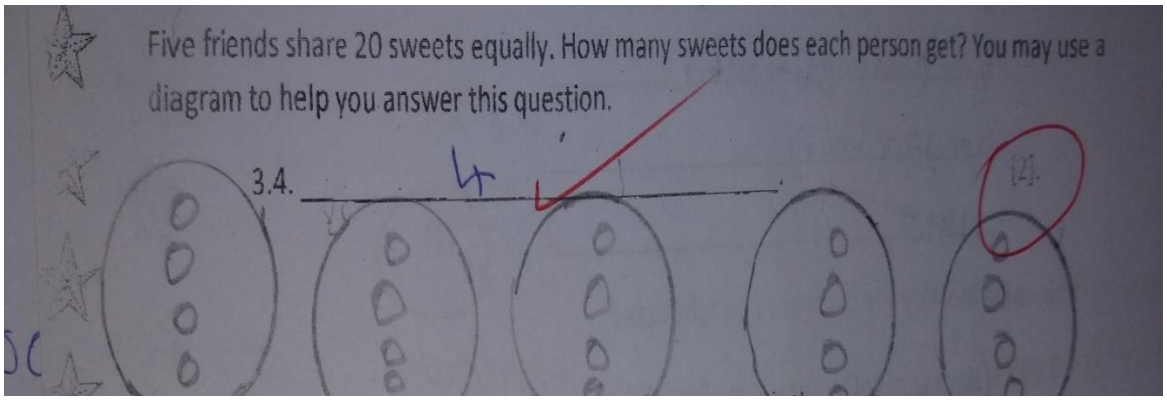


Figure 4.18: Sipho's work on a division sum

4.3.4 Accessibility of PCK using visual representation in a mathematical classroom

Visual representations are tangible objects that teachers use to make their work easier in a learning environment (Maboya, 2014:68). Learners learn by associating things, therefore young children enjoy playing with physical objects, and using these objects in a mathematics classroom, assists teachers in enhancing young learners' problem-solving skills, especially in word sums. When teachers use the manipulatives effectively (DoE, 2012:5) during the teaching of operations in mathematics, learners begin to enjoy the lesson, even the less capable ones do not encounter problems, because the lesson comes with real objects, which young learners find attractive in mathematics settings (cf. 2.4.2.4). The DBE (2003:30) attests that teachers need to vary the teaching and assessment strategies, to cater for all learner types in a mathematics classroom. However, the constructivism theory by Vygotsky is vital in this regard, as visual representation scaffolds learning and learners' problem-solving skills are enhanced in solving word sums. When teachers bring visual representations as

learning support material, learners feel free to take charge of their learning and enjoy that lesson to its fullest.

The team was gathered in a grade 4B classroom waiting for Mr Snake to present his lesson: Mr Snake greeted the learners and started his lesson.

Mr Snake*:*

> *Learners, with me are containers with counters of different colours. I need 5 leaners that will collect as many counters of the same colour as possible. I will give you seven minutes to finish this activity, are you ready?*

Learners:

> *Yes, Sir.*

Learners rushed to the containers and started to collect the counters and arranged them as they were instructed.

Mr Snake:

> *Your time is up my friends. Now start counting how many counters did each of you collect?*

Sam: *I collected 13 counters.*

Sipho: *I collected 22 counters.*

Lungisani: *I collected 27 counters*

Nombuso: *I collected 19 counters.*

Xolani: *I collected 12 counters.*

Mr Snake:

Ok my friends, go back to your places. I want you to sit in fours and start counting how many counters are we having altogether.

All the groups showed their work to Mr Snake. This is what they did:

22 + 27 = 49 + 19 = 68 + 12 = 80 + 13 = 93.

Mr Snake:

Well done! My friends, you got it right.

Miss Saliva:

I like the way you have presented your lesson Mr Snake. Your instructions were clear and learners did not encounter any difficulties at all.

Mr Gxaba:

The fact that learners were given an opportunity to work individually and in groups was evidence that not one approach to teaching was used by Mr Snake.

Mr Snake: *If grandfather takes 2 tablets for the pains in the morning, 2 in the middle of the day, 2 in the afternoon and 2 at night. How many tablets he ends up taking the entire day?*

Scelo: *Eight tablets.*

Mr. Snake: *Good,Scelo. Now can you calculate how many sugars can be put in 6 cups of tea if 3 sugars are put in one cup of tea?*

Nombuso quickly did her calculations and presented it as follows:

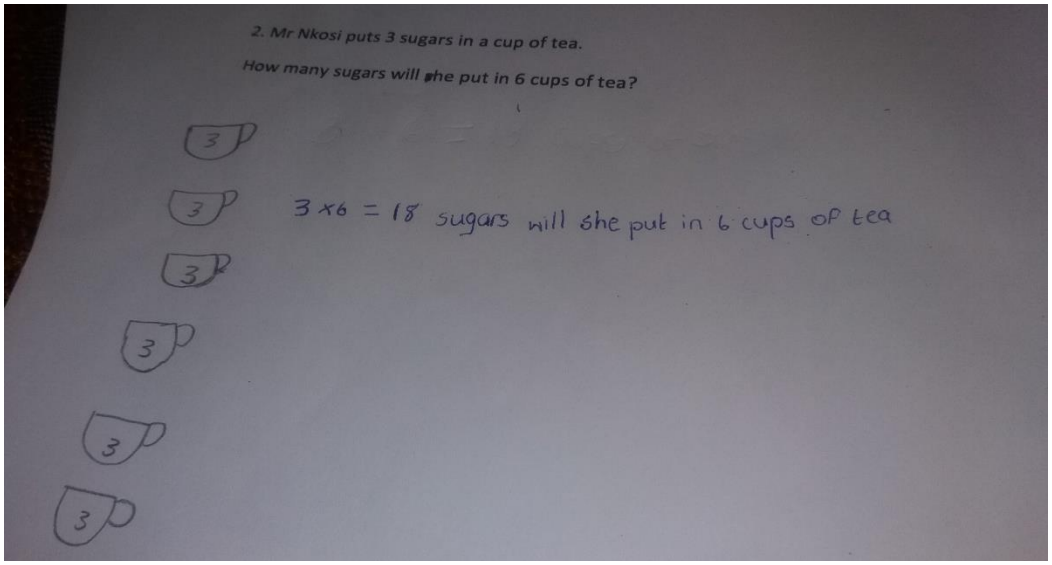
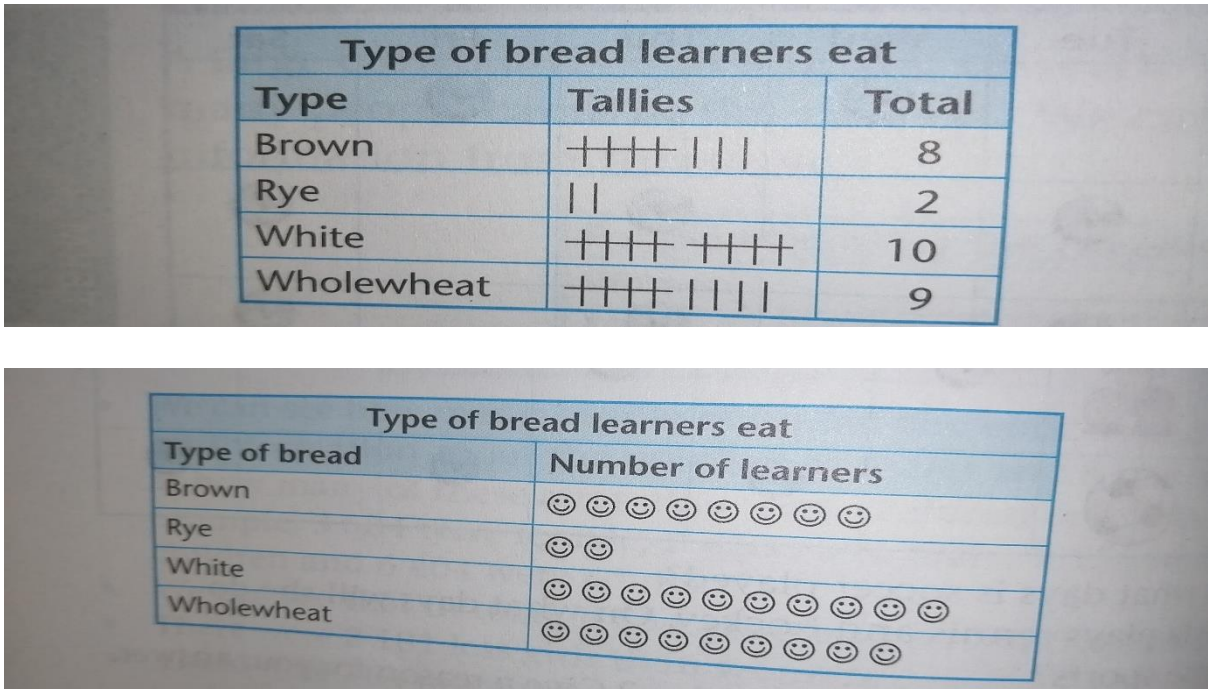


Figure 4.19: Nombuso work on a visual representation

Based on the above extracts it is clear that Mr Snake's lesson did not give learners difficulties. Learners were able to follow the instructions and responded positively throughout the lesson presentation. PAR was evident in this lesson, as all learners actively participated and interacted with one another in groups in finding solutions. Mr Snake was able to apply the multiplicity of bricolage (Rogers, 2012:5) by using a variety of methods, approaches and perspectives with the available material he had to enhance the problem-solving skills for grade for learners. Grouping learners is the best seating arrangement that promotes cooperative learning in a mathematics classroom (Mokotjo, 2017:153), because even shy learners get an opportunity to share with peers without the intervention of the teacher (Flynn, 2013:2). Visual Representation is also evident in activities where learners are taught to decode information in the form of tally tables, pictographs and bar graphs. VR, as literature has shown, is one of the best devices in enhancing learners' problem-solving skills in word sums. Following are examples where grade 4 learners use tallies and pictographs to encode information. Example: learners were asked what type of bread they eat. Each learner had to choose from the following types: brown, rye, white and whole-wheat. Findings were represented in a tally table and a pictograph for better understanding



Type of bread learners eat		
Type	Tallies	Total
Brown	𝍸 |||	8
Rye	||	2
White	𝍸 𝍸	10
Wholewheat	𝍸 ||||	9

Type of bread learners eat	
Type of bread	Number of learners
Brown	☺☺☺☺☺☺☺☺
Rye	☺☺
White	☺☺☺☺☺☺☺☺☺☺
Wholewheat	☺☺☺☺☺☺☺☺☺

Figure 4.20: Visual Representation in a form of a tally table and pictograph

4.4 CRITICAL CONDITIONS OF THE SUCCESSFUL IMPLEMENTATION OF THE STRAGEGY TO ENHANCE GRADE 4 LEARNERS' MATHEMATICAL PROBLEM-SOLVING SKILLS IN WORD SUMS

Researchers have shown that there is not only one single strategy that can be used to enhance problem-solving skills for learners in mathematics (Zerafa, 2015:1181), but a planned programme by members of a team with a common vision can assist in realising this goal.

4.4.1 Team-teaching in word sums problems

Team-teaching is an approach that is used by teachers to help one another in instilling knowledge, skills and values to the learners in a form of teaching (cf. 2.4.3.1). In addition, team-teaching makes it easier for teachers to teach learners the same content, using various methods and approaches towards an end goal (Mokotjo, 2017:53). Furthermore, team-teaching also benefits learners, because one content can be presented in different ways by different people and produce different results. Learners learn at different paces from one another, and teachers therefore need to create different learning opportunities for different learner types in class so that

learners will be able to demonstrate the knowledge, skills and values they acquired during their learning (DBE, 2003:32). Experienced teachers get an opportunity to assist inexperienced teachers with aspects they are not clear about in teaching learners, in that way both teachers and learners' benefit from this kind of experience. In team teaching, not only novice teachers benefit from experienced teachers, even newly appointed teachers can assist the experienced ones with the innovative methods of teaching. In so doing, grade 4 learners' problem-solving skills in word sums will be enhanced.

During Mr Snake's presentation when learners were instructed to collect counters from the containers, learners became chaotic, because they all rushed to the table until another teacher intervened by saying:

Mr Yende:

> *Ok learners, let us try and do this activity in a very civilised manner without creating a havoc. I can see that you enjoy this lesson but let us not make noise. Go to the table and pick up the counters as quietly as possible. Learners that make noise will be disqualified from participating, understood?*

Learners:

> *Yes, Sir.*

Miss Khathi*:*

> *Another thing learners, the group that will finish first will be rewarded, therefore try by all means to work as quickly as possible but in a quiet manner.*

Parent:

> *Yazi ke bengingakazi ngicabange ukuthi izingane zike zikhombise ukujabula uma zifunda izibalo. Bengizitshela ukuthi uma kufundwa izibalo izingane ziba nokwesaba uthisha zithule zingabangi msindo.*
>
> [I never thought learners can be as chaotic during the teaching and learning of mathematics, I was under the impression that fear of a mathematics teacher makes them keep quiet.]

Based on the above extracts, it is evident that the lesson was successful, due to the fact the co-researchers participated actively, as PAR requires them to do, since PAR

is a qualitative approach that allows people freedom to share ideas in a meaningful way, in realising the intended goal (Malebese, 2016:90). Team-teaching created many opportunities for learners, even for shy learners, because the lesson acted as a form of play and children enjoy playing. Team-teaching does not only help learners; teachers also get opportunities where they help one another as teaching progresses. Experienced teachers also learn new approaches and methods of teaching from recently qualified teachers who are new in the teaching profession. On the other hand, it is learners whose problem-solving skills were set to be enhanced. When children play while learning, their self-esteem is enhanced and so are their problem-solving skills. The principles of PAR were evident in this kind of learning, because all learners were actively involved (cf. 3.2.3) while the multiplicity of bricolage also prevailed when the teachers used whatever materials were available to enhance grade 4 learners' problem-solving skills in word sums. However, empirical data was informed by literature reviewed in chapter two. Even though the team-teaching approach was used to enhance grade 4 learners' problem-solving skills, learners still had a challenge in solving word sums.

4.4.2 Peer-tutoring in the teaching and learning of word sums

Any work done in a group is group work while peer-tutoring speaks of learners in the same age group helping one another by sharing ideas in a learning environment (cf. 2.4.3.2). When learners interact with their peers, without the intervention of the teacher, they become more interested in learning, because they don't feel shy around their peers. Working as a group in peer-tutoring promotes oneness and team spirit, because learners speak the same language, unlike when they receive instructions in the language they struggle to understand. In peer-tutoring learners get to ask questions where they don't follow and do discussions in a better understood language without fear of being reprimanded by the teacher when things do not go well. Group work teaches learners that in life some goals are achieved collaboratively by joining forces with others better than individually (DoE, 2012:5). This was evident in Mr Snake's presentation where group work was successfully demonstrated as learners added the number of containers together.

During the discussion meeting, a parent made the following comment:

Yazike bengingazi ukuthi uma abantwana befundisana bodwa bayakwazi ukulalelana bagcine bephume nezimpendulo. Mina bengithi izingane zizwa uthisha kuphela.

[I did not know that learners can actually listen to one another in peer tutoring, I thought they only pay attention to the teacher.]

Deputy Principal:

Some teachers are harsh with learners, as a result learners get scared to come out even when they know the answer, but around their peers they feel free to give their voice openly.

Principal:

> *Sometimes teachers create barriers to learning unintentionally, i.e. speaking to learners in a loud voice can hinder effective teaching. However, introducing peer tutoring into a learning environment impacts positively in children's learning.*

Senamile:

> *Ngisithokozele nami isifundo sika Mnumzane uNyoka, kanjalo nabafundi abanye bajabulile ukufunda samdlalo, engathi singahlala sifunda kanjena njalo uma sifunda izibalo.*
>
> [I enjoyed Mr Snake's lesson very well and so did my classmates. I wish we could always learn mathematics in that manner.]

The research team, during the reflection stage, came to the conclusion that learners working in groups and peer-tutoring have better results than when learners work in solo. This kind of learning style emancipates learners to have good relationships with peers, in order to achieve the ultimate goal. Allowing learners to interact with one another and introducing games to play as they learn, will bring joy back to a mathematics classroom and their problem-solving skills will be enhanced. Learners working together in groups get an opportunity to own their learning and that which they discovered themselves, they will not forget easily. In conclusion, empirical data and reviewed literature were in line even though grade 4 learners are not all proficient in solving word sums, which propels the researcher to discuss another condition that will contribute towards the success of the study.

4.4.3 Relevant Pedagogical Content Knowledge in the teaching of word sums

Ball *et al.* (2008:3) view PCK as a comprehension of the components that lead to effective learning of specific topics (cf. 2.4.3.3), bearing in mind learners' ages and socio-economic status as they come to the learning environment. They further attest that PCK inculcate content knowledge with teaching methods, ascertaining what is taught is adherent to the curriculum. The DBE (2012:4) serves to prepare all learner types, regardless of their background, status and abilities, to acquire as much knowledge, skills and values, which they will use locally and globally in real life situations. This requires teachers to undergo professional training so they will be able

to equip learners, using a variety of methods and approaches. Mathematics teachers should have a conceptual understanding of mathematics, which will influence teaching and learning in a positive way (Turnuklu & Yesildere, 2007), taking into consideration what learners already know and what they don't understand, in order to enhance their problem-solving skills in word sums (Mishra & Koehler, 2006:1027).

Miss Saliva called upon Bheki to come in front of the class and started her lesson.

Miss Saliva: *Look at Bheki' s hands (showing them up) and tell me how many fingers does he have all together*.

Many learners raised their hands but Miss Saliva pointed at Simo.

Simo: *Ten fingers, Miss*.

Miss Saliva: Come Thuli, Bongi and Tshepho. Can somebody tell me how many fingers do all these learners have?

Few learners raised their hands but Miss Saliva pointed at Simlindile.

Simlindile: *Forty fingers altogether.*

Miss Saliva: *Can you tell the class how did you arrive at the answer?*

Simlindile: *Simo has 10 fingers, Thuli has 10 fingers, Bongi 10 and Tshepho 10. There are 10 fingers in a*ll.

Miss Saliva*: Good, Simlindile. We can also write this sum as 10 fingers×4= 40 fingers or 4×10 fingers = 40 fingers. We can write Simlidiles' sum as 10+10+10+10 =40*

The deputy principal (Mrs Deyi) made the following remarks:

> *What I observed is that learning while associating things makes things easier for the grade 4 learners.*

Miss Khathi:

> *I definitely agree with you Mrs Deyi on that. I am certain that real objects assist learners in understanding mathematical concepts.*

The research team agreed on the fact that learners understand better where there are scafolders that support their learning when word sums are taught. The multiplicity

of bricolage was also evident when the teacher used any material available to make her lesson better understood by all learners. PAR requires those in the research to be actively involved, however, the teacher engaged learners in a manner that allowed them to deduce from what they had seen in front of them. Relevance of PCK was evident as bricolage and PAR were infused in lesson presentation

4.4.4 Teachers' communication skills and attitude towards mathematical word sums

Van de Walle (2004:32) attests that there should be good communication lines between teachers and learners for effective teaching and learning to take place. Teachers therefore need to create a positive learning environment where learners will feel free and happy to work in (cf. 2.4.3.4). The manner in which teachers address learners during teaching and learning impacts either positively or negatively on learners. A teacher's positive attitude when teaching learners, leads to positive results, because learners view their teachers as role models in their learning (See section 2.4.3.4). The DBE (2012:8) states that mathematics is a language that entails symbols to describe different kinds of relationships in physical and social contexts to enhance logical and critical thinking in mankind. To achieve this, teachers need to allow learners to sit in a manner that makes them comfortable around their peers, and where they speak openly with one another without fear of others. Teachers should speak in a friendly manner so that learners are be able to communicate with them openly for effective teaching and learning of word sums.

The research team met in grade 4A class and discussed other factors that contributed to the successful lesson presentations. Their comments were as follows:

Mrs Deyi:

> *I liked the way Mr Snake communicated with his learners. He gave the direct orders and learners responded positively. There was order which means the communication lines were clear to all.*

Miss Saliva:

I do not speak friendly to my grade six leaners because they will take advantage and don't pay attention to what I say. I make sure that I do not play with them during their learning because in doing that I will be creating a chaos in class.

Mr Yende:

> *Lady teachers make learners uncomfortable during teaching and learning. They address learners with their body parts when they performed poorly during assessment, e.g. (big head etc.) this demotivates learners and lowers their self-esteem.*

The afore-mentioned comment seems to be a general one.

Based on the above excerpts, the manner in which teachers speak to learners during teaching contributes to learner performance. When learners are addressed in a friendly manner, their self-concept becomes positive and their attitude as well. When harsh words are uttered towards learners, they become self-absorbed and refrain from participating and that impacts negatively on their learning. Learners end up hating the subject and despising the person teaching that subject. Good communication leads to good learning. The team encouraged one another to open lines of communication where learners will feel free to work around their peers and be able to ask questions where they do not understand. The team felt that teachers should always give positive feedback to learners, in order to motivate and encourage them to always strive for the best. By so doing learners' problem-solving skills will be enhanced. Mr Snake's presentation created a platform where almost the entire class actively participated, as stipulated in the principles of PAR (cf. 3.2.3), which promotes oneness and active learning. Also, bricolage was evident in Mr Snake's lesson where its multi perspectival, multi theoretical and multi methodological stance was observed. In addition, there was alignment in empirical data and literature that was reviewed in Chapter two.

4.4.5 Summary

This section discussed the conditions under which the strategy would be successful. The strategy would be successful when team-teaching is practised, using multiple methods, multiple perspectives and multiple methodologies of bricolage, where any material at hand would enhance grade 4 learners' problem-solving skills in word sums. Another success will be the grouping of learners with an aim of developing their skills of sharing ideas, which is supported by PAR as research methodology that requires co-researchers to interact with one another and to engage actively in activities that will enhance learners' problem-solving skills. The strategy will be successful when

teachers create a positive learning environment where learners will feel free and safe to work in. This learning environment includes positive attitudes on the teachers' side and good communication lines that will give learners the freedom to ask questions whenever they encounter challenges in their learning. This will be achieved when all co-researchers fulfil their roles as required and grade 4 learners' problem-solving skills will be enhanced.

4.5 THREATS IMPEDING THE SUCCESSFUL IMPLEMENTATION OF THE STRATEGY

This section discusses the possible hindrances that might impede the successful implementation of the strategy. Amongst these hindrances are accessibility of resource material in mathematics classrooms, factors threatening learner pace in the teaching and learning of word sums, factors threatening teachers' Pedagogical Content Knowledge in mathematics classrooms and factors affecting learners' attitudes in the teaching and learning of word sums.

4.5.1 Accessibility and proper use of resources in the teaching and learning of word sums

Accessibility of resources means that teachers should ensure that technology and science are critically and effectively used in the teaching and learning of word sums (DBE, 2012:5). The efficiency and the quality of education in our country would be attained by having a high number of resources (cf. 2.4.4.1). These resources are categorised into human resources: Teaching and Learning Material (TLM) and physical and financial resources. Time is also one of the most important resources in as far as teaching and learning is concerned, because time wasted can never be recovered. The school where research is conducted is situated in a rural area, and the school is under resourced with four mathematics teachers for the intermediate and the senior phases. These teachers were part of the research team who sometimes could not make it to the meetings, due to other commitments. This made things difficult for the study to reach its ultimate goal. Another challenge was on financial constraints,

because the study took place on weekends and after school's notional time, and it was challenging to finance educators to get to their residential areas.

Teachers could not use extra TLM to support learners, because it had to come out of their pockets, as mentioned earlier on of a shortage in resources. An example of this is when one of the co-researchers failed to make provision of the TLM on his lesson about the body parts of six cows. It was difficult for learners to make calculations, because only one cow was drawn on the board and the other five were not visible to learners. Learners could have done better had they seen all the other cows on a chart. During the discussions the co-researchers made the following comments:

Miss Khathi:

> *During Mr Yende's presentation, the unavailability of the TLM made it difficult for learners to get the right answers from the questions that were asked by the teacher.*

Mrs Deyi:

> *Yes, young learners learn by associating things. The lesson was quite interesting because the topic was about the cows learners come across every day as they come to school. It was not something they did not know.*

Principal:

> *I did not realise that it is imperative to use resource material in a mathematics classroom, but now I understand how much young learners need to be supported with TLM. It would have been easier for them to calculate the body parts of the cows had they seen all six cows on a chart.*

The above excerpts are evidence that it is always important to plan properly before going to the classroom. For effective teaching and learning to take place, teachers should try by all means to cater for all learner types when presenting lessons. Some learners learn fast while others are struggling and need support to scaffold their learning. However, the availability of TLM in a learning environment is a necessity in order to support all learners, less capable ones at the most. Not using the TLM during teaching and learning is a barrier to learning for other learners who learn better when they are supported by the TLM. Teachers should try by all means to make learners' learning much easier, so as to achieve the end goal. Learners whose learning has been supported by TLM, perform better than those that are taught mathematical word

sums abstractly. Lastly, empirical data in this section complement literature that was reviewed in chapter two of the study. This brings the researcher to the next topic which is learner pace threatening the assimilation of mathematical concepts in the teaching and learning of word sums.

4.5.2 Learner pace when learning word sums

There is an implication in the teaching and learning of mathematics that it cannot be raced, but at the same time the curriculum should be completed within the scheduled time frames. It should always be taken into consideration that learners learn at a different pace in different contexts (DBE, 2003:23), and are taught by different teachers. Learners have pre-existing knowledge that they obtained from the previous grade. This existing knowledge is the one that will help them to build up on as they progress to the next grade (Applefield *et al.*, 2001:8). Effective teaching is embedded on an understanding of mathematics and what learners know and what they need to know (DBE, 2003:24). It is true that the levels of understanding differ from child to child. Even in a mainstream schooling, learners do not perform at the same level, because of their different abilities. Some learners do not experience any difficulties when they are being taught, some experience minor problems, while others find it too difficult to understand and take too long to assimilate mathematical concepts (Bird, 2012:113).

There are other factors that contribute to learners' poor performances, which build the barriers to their learning. A few examples are physiological barriers, such as poor eyesight, deafness, stuttering, etc. (cf. 2.4.4.2). Learners with such barriers need to be given extra time during teaching and also during assessment. That becomes a problem on its own, because time is limited and allocated according to the number of topics to be covered within prescribed time frames. It is therefore not easy to plan activities that will suit all learner types in mathematics. Differentiation is difficult to implement in mathematics settings, due to time constraints and shortage of resource material especially in a research site.

Following are the comments by some of the co-researchers during a discussion meeting.

Mr Yende:

These learners are too slow to assimilate some mathematical concepts within the scheduled period. This gives us problems, because time is not on our side.

Miss Saliva:

Not all learners are struggling in mathematics, but how do we assist those with difficulties so that they are not left behind?

Miss Khathi:

I suggest that learners with difficulties be given extra work to do at home for them to catch up.

Mr Gxaba:

I agree, parents should assist their children at home and do their part, in this way we are all involved in children's learning.

Parent:

Some learners stay with their grandparents who did not go to school. How will those children be assisted with their homework?

Mrs Deyi:

Maybe parents will have to ask older children from the neighbours to assist. Teachers have done their part at school.

During the reflection, the co-researchers were worried about learners that were experiencing difficulties in finishing the tasks within the allocated time. Learner pace became a challenge on its own, which needed to be addressed further. In addition, the problem is that teachers were using their extra time already participating in the study, therefore, they could not offer more of their time than what they already sacrificed. Time constraints impacted teachers to give extra support to learners that are slow in assimilation of mathematical concepts. However, teachers suggested the idea of involving retired teachers in assisting less capable learners with their homework with an aim of enhancing their problem-solving skills in solving word sums. The team supported the idea for future use and the meeting adjourned. Involving human resources and other TLM is evidence of bricolage and PAR in an inquiry, which was evident in this presentation.

4.5.3 Factors threatening teachers' Pedagogical Content Knowledge in mathematics classrooms

According to Jepketer, Kombo and Kyalo (2015:38), mathematics teachers should have knowledge of the subject and how to deliver and impart that knowledge to learners they teach. They should know various techniques and methods to teach a particular concept and what learners should do at the end of the lesson (Hill *et al.,* 2008:563), and when to assess learners on what they have been taught. SCK entails knowledge of facts, approaches, theories and different methods mathematics teachers need to teach a subject (cf. 2.4.3.3). Furthermore, they need sound mathematical concepts, in order to assist learners, improve their problem-solving skills. SCK infused to PCK or vice versa can assist teachers produce learners that can compete locally, provincially, nationally and even globally (DoE, 2012:4). When teachers lack content knowledge and how that content is conveyed to learners, ultimately learning will be compromised and that wastes a lot of time as a resource. The DBE (2012:4) mentions that the curriculum that is being implemented should equip learners in a way that will benefit learners. However, unavailability of the SCK becomes a threat when teachers come to teach unprepared and expect learners to be proficient. In a discussion meeting, teachers made the following comments:

Mrs Deyi:

> *Telling learners to take out their workbooks and do an activity there on, as far as I know is not effective especially if the lesson was presented for the first time. It is clear enough that the SCK was not available because the lesson was not well planned for. That would be acceptable had it happened at the end of the lesson to consolidate what had been taught.*

Miss Saliva:

> *Teachers should always bear in mind that they first teach the content to learners before expecting learners to apply the knowledge and skills in given assessment tasks. Teachers are not allowed to assess what they did not teach learners, it is not what the curriculum stipulates.*

Mr Gxaba:

> *We should teach the content using different methods in order to accommodate all learners before we assess them, it is only fair to do so.*

The above excerpts are an indication that accessibility of Subject Content Knowledge was indeed a hindrance in the implementation of the strategy to enhance problem-solving skills for grade 4 learners in solving word sums. Teachers have a role of implementing the curriculum, meaning that they have a responsibility of teaching learners before they assess them. Assessing learners without instilling knowledge first is doing an injustice to them. Ball *et al*. (2008:4) and Haylock and Manning (2014:1) concur that teachers should have knowledge of what they need to teach learners and the methods of how to impart that knowledge for effective teaching. Learners should be given opportunities where they interact with peers in groups, so they will share ideas and help one another. Grade 4 learners are the beginners to LoLT, therefore they need teachers who know the content of mathematics very well, as teachers with a positive attitude towards helping them, acquire as much knowledge and skills as possible. The multiplicity of bricolage and PAR are the best devices that teachers can apply to enhance the learners' performance in mathematics, word sums in particular, which were not evident in other lesson presentations.

4.5.4 Misconceptions in the teaching and learning of word sums

Arslan, Yavuz and Deringol-Karetas (2014:557) mention that among the many reasons why young learners struggle in solving word sums is not understanding the concept. This is because of their inability to conceptualise word sums; therefore, they end guessing the answers having not done proper calculations. Furthermore, their inability to solve mathematical word sums leads to the change of attitude, due to the fact that they feel ridiculed by their peers who think they are better than them in knowledge production (cf. 2.4.3.2). In addition, teachers themselves fail to guide learners towards getting to the correct answers and make assumptions that learners know and understand the text. This is reason why less able learners are to be catered for and inclusivity be applied in mathematics classrooms (DBE, 2012:5) in a mathematics setting.

In a grade 4B class, Miss Bu is presenting her lesson as follows:

Miss Bu*: Learners, solve the problem below:*

Sindi collected 55 while Zodwa collected 47 bottle caps. How many more than Zodwa's bottle caps did Sindi collect?

There was silence in the classroom. The teacher repeated the statement again.

Miss Bu: Sindi collected 55 while Zodwa collected 47 bottle caps. The question you must answer is; How many more than Zodwa's bottle caps did Sindi collect?

Lunga: 92 bottle caps

Vumani: *12 bottle caps*

Miss Bu: *Both your answers are wrong. You are just guessing. What is difficult in solving this problem?*

During reflection, the team were of the view that the teacher could have guided learners towards the answers and not to judge them. The teacher changed the tone towards learners instead of assisting them for them to understand the text. The bricolage model was not applied during lesson presentation, where multiple perspectives and methods were used in clarifying difficult words learners did not understand.

Mr Snake: You could have allowed learners to use the counters so they would be able to solve the problem.

Mr Gxaba: Young learners cannot do calculations abstractly, they need scafolders for their problem-solving skills to be enhanced.

The team held the view that the teachers should make it their responsibility to create an atmosphere where learners feel free to interact with them and to ask questions where they are not sure of what to do to solve the sum. In so doing, they would be expanding the principles and objectives of PAR, as well as the multiplicity of bricolage, as it is the lens used in this study.

4.5.5 Summary

This section discussed the hindrances in the implementation of the strategy to enhance problem-solving skills for grade 4 learners in word sums. The availability of the TLM in a mathematics classroom is necessary to support learners for a better understanding of mathematical concepts. The TLM makes teaching easy for the teachers and learning for learners. It scaffolds learning (Vygotsky), as learners

construct meaning out of the given text. Bricolage supports the use of any material available (Rogers, 2012:7) when mathematics is being taught. Learners' pace at assimilating mathematical concepts was mentioned, where teachers are made aware of the pace at which learners learn; that they should accommodate them as well, because some learners learn fast while others take too long to master some mathematical concepts. Unavailability of the SCK is also a hindrance in the teaching and learning of mathematics, because teachers should know what to teach (content) and how (methods) to teach learners before assessing them (Menheere & Hooge, 2010:144). Emancipating parents about the importance of learning mathematics and the goodness it brings to the lives of children and to the economy of the country, will change the mind-set of learners towards the learning of word sums and their problem-solving skills will be enhanced.

4.6 INDICATORS OF SUCCESS IN THE TEACHING AND LEARNING OF WORD SUMS

This section discusses the indicators in the successful implementation of a strategy that will enhance mathematics for grade 4 learners' problem-solving skills in word sums. Examples to be used in accomplishing the mission are: essence for understanding mathematical texts and keywords in the teaching of word sums, effective consolidation of mathematical language and vernacular in mathematics classrooms, effective utilisation of visual representation in the teaching and learning of word sums and positive learner attitudes in the teaching and learning of word sums.

4.6.1 Essence for understanding mathematical text and keywords

Effective understanding of mathematical text and keywords was steered and developed through social interaction that took place in the learning environment. (Malebese, 2016:209). Learners need to understand mathematical concepts and keywords to be able to understand the text (cf. 2.4.5.1). However, learners should solve problems in contexts and do context-free calculations (DBE, 2012:43). The team therefore worked very hard and tirelessly to develop activities that attempted to address the challenges grade 4 learners are experiencing during the teaching and

learning of word sums. Attempts made were to achieve the end goal, which was to enhance problem-solving skills for grade 4 learners. Following are the samples of learners' assessments after several presentations by mathematics teachers who participated in the study. These assessments are evidence that most learners understood and mastered mathematical concepts and keywords to the text.

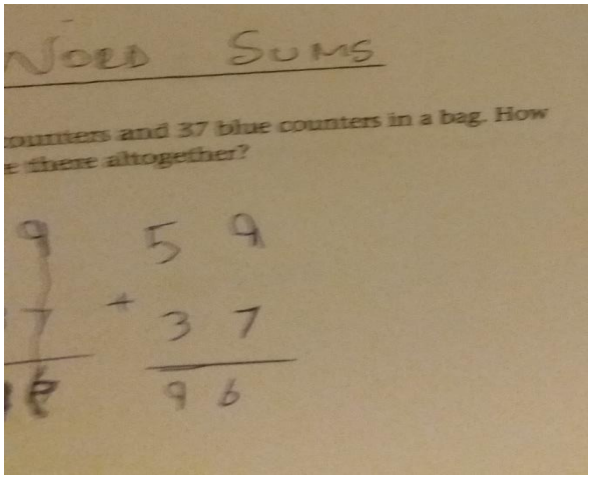


Figure 4.21: Sipho's work after mastering the concept

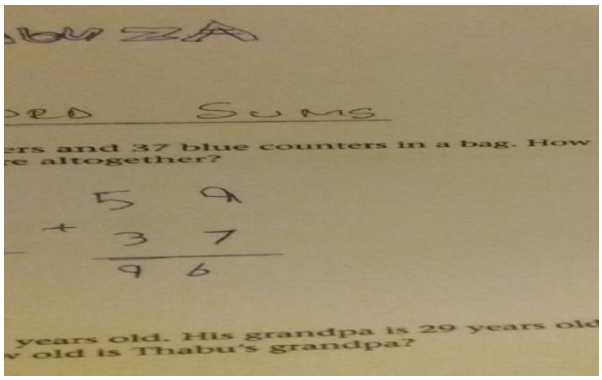


Figure 4.22: Lungisani's assessment showing a well understood concept

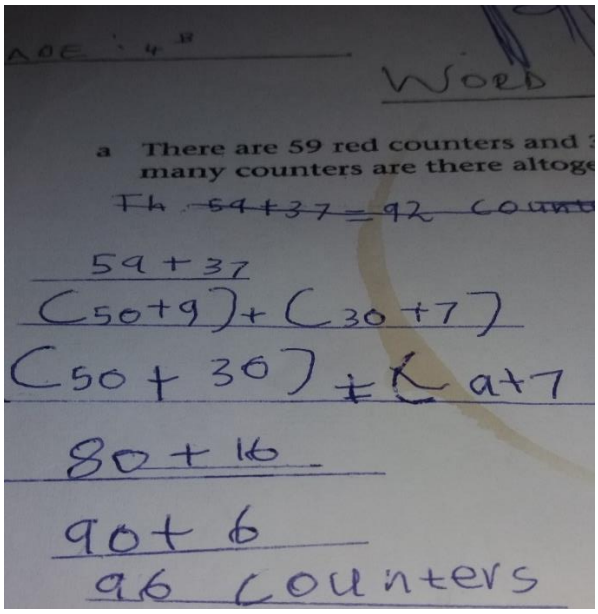


Figure 4.23: Nombuso's work on addition

During the discussion meetings, the research team agreed that through an understanding of mathematical text and keywords, learners are able to solve word sums on their own and without difficulties (Mokotjo, 2017:161). Being able to solve word sums without the usage of visual aids or diagram is an indication that these learners mastered the concept and that no support from peers was needed. However, levels of understanding differ from learner to learner. Some learners take too long, while others do not take much time to assimilate the mathematical concepts. These learners showed that the multiplicity of bricolage was employed, as teaching was done in different approaches and different methods. This is seen in learners' assessments above, as they wrote the sum differently. Following are the comments from few teachers:

Principal:

> *Well done! My children, I did not anticipate that you would do it right.*

Mrs Deyi:

> *I like the way this one learner used the breaking down and building up method – that was superb.*

Miss Saliva:

> *This is all the hard work of our colleagues. They worked so diligently and enthusiastically towards enhancing the problem-solving skills for grade 4 learners in solving word sums. Credit goes to them as well.*

Nombuso*:*

> *I am happy that I can solve word sums without struggling like I did in the beginning.*

Ntando*:*

> *Word sums are not easy to master, but at least we have an understanding of keywords, which is key to solving word sums. Thank you, teachers, for making it possible for us.*

The above excerpts are an indication that the team was happy about the teachers' and learners 'work. It is true that working together as a team produces the best results and that learners got to see how well they had understood the concept. The usage of PAR as research methodology and the multiplicity of bricolage showed that the study

is not one person's baby, but the entire teams who took part in it. Learners were happy that they impressed the teachers after realising that their activities were correct. When learners help one another in groups, the less capable ones end up gaining confidence and develop the ability to work on their own in completing the tasks. In conclusion, when learners understand mathematical texts and keywords, they are able to use the right operation to solve the word problem, and their problem-solving skills are enhanced. Good examples of these keywords are more, less, take away, share, equally, divide, and many more.

4.6.2 Effective consolidation of mathematical language and vernacular languages in mathematics classrooms

According to Winford (2007:22-40), diverting to vernacular is vital when teachers use it to facilitate learning. Some learners in grade 4 find it difficult to comprehend the LoLT when teachers are teaching mathematical word sums. This is the time where teachers divert to learners' mother tongue that they begin to understand what is expected of them during teaching and learning. Diverting to vernacular is not an offence when the South African curriculum is being implemented, as long as it is done within the paradigms of the eleven official languages stipulated in the South African Constitution (cf. 2.4.5.2). Explaining to learners in mother tongue what they do not understand in English makes it easier for teachers to complete the tasks without difficulties. Learners gain confidence when certain concepts are explained in the language they clearly understand (Jegede, 2012:41). Research has revealed that in schools where teachers diverted to mother tongue to explain some of the mathematical concepts, learners' performance in word sums improved (Molotja, 2008). Explaining some mathematical concepts in mother tongue does not necessarily mean that the entire teaching is done in mother tongue. It rather paves way towards better understanding of complex texts for grade 4 learners. Following are the samples of learners' work after the teacher diverted to learners' home language:

Miss Mkhabela:

> *Kunamantombazane awu 32 nabafana abawu 57 ebangeni lakwa Gr.4. Uma uhlanganisa inamba yabafana neyamantombazane bazoba bangakhi abafundi ebangeni lesine?*

Miss Mkhabela: *There are 32 girls and 57 boys in a grade 4 class. How many learners are in a grade 4 class?*

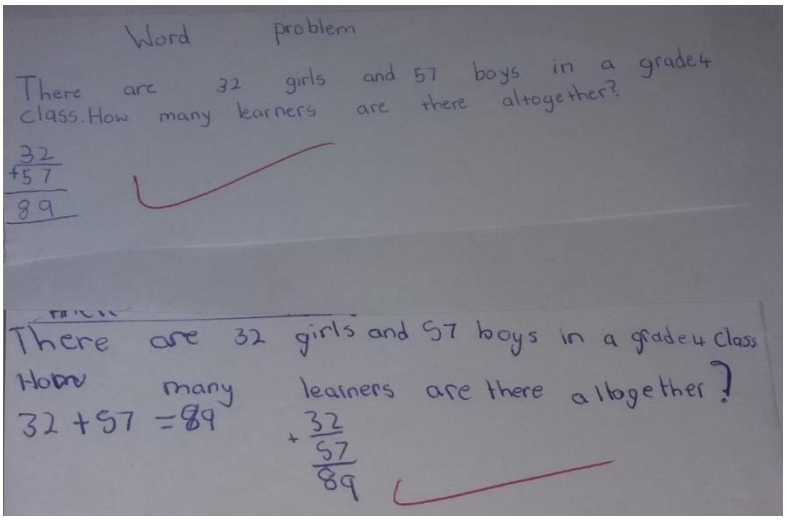


Figure 4.24: Leaners' assessments on a well- mastered concept

During the reflection session, the research team made the following comments on learners' work:

Miss Deyi:

It is easy for learners to work out the problem once it has been translated into mother tongue. Learners understand quite clearly in their mother tongue than in LoLT.

Miss Saliva*:*

Using vernacular languages during examinations is not allowed, except when it is language of particular race that is being written. Learners do understand mathematical concepts as the teacher switches the code during teaching and learning, by the time tests are written, learners do not need teacher's translation, because they have already mastered the concepts during classroom interaction.

Mr Snake:

If learners are given more examples during teaching and learning, they get used to the idea and don't encounter problems during the assessments even when vernacular is not used in a mathematics classroom.

Looking at the learners' work above, it is evident that switching to learners' vernacular impacted positively in enhancing grade 4 learners' problem-solving skills in solving

word sums. Winford (2007:22-40) attested that teachers' use of vernacular languages as a mechanism, makes learning easier when some of the concepts are explained in learners' mother tongue. Furthermore, grouping learners is also one mechanism of helping them, because in such groups they use their mother tongue when they share ideas. In addition, learners perform better in schools where teachers switched to learners' mother tongue, in order to enhance learners' problem-solving skills in word sums (cf. 2.4.5.2). To conclude, diverting to vernacular languages during teaching and learning prepares learners with knowledge and skills they will use when they are working alone at home doing homework, as well as when they are assessed at school in formal tasks. What learners learn in vernacular is easily absorbed in their minds and is stored in their long-term memory for future use. Lastly, the above learners' assessments indicated that they did not encounter any problems in understanding the text and applying the suitable equation in solving the problem.

4.6.3 Impact of visual representation in a mathematics classroom

Learners learn better when they associate things. This was evident in activities that were done during data collection. Learners get excited and understand better when visual representations and manipulatives are used to give a better understanding of the text in a mathematics classroom (cf. 2.4.2.4.). Visual representations scaffold their learning without the teachers' involvement. All learners, even those that have learning disabilities, understand better when there are pictures, drawings and even real objects that they can relate to, for meaning-making in the learning environment, than when problem-solving activities are learnt abstractly and in isolation (DBE, 2012:5). In order to successfully enhance grade 4 learners' problem-solving skills, teachers should make use of diagrams, pictures and other forms of visual representation during teaching and learning of word sums. Following is evidence of learners' assessed activities where visual representations were used.

In a grade 5A class, Mr Yende is ready to present his lesson. He begins his lesson by issuing handouts to the learners.

Mr Yende: (*Reading aloud from the handout). (a) How much do these bananas cost if one banana costs R2.00?*

(b) How much do these apples cost if each costs R1.50? Use the papers I have just given you to do your calculations

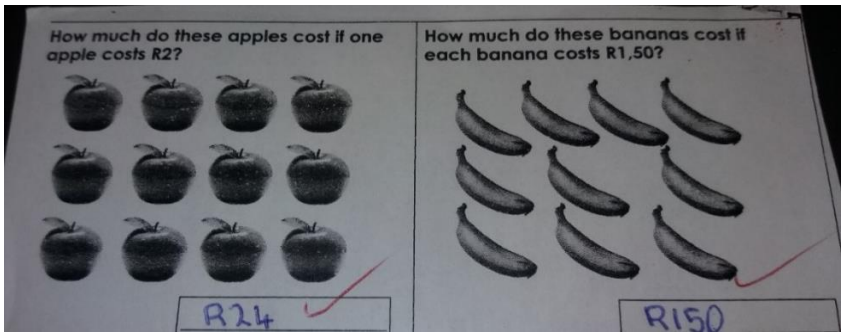


Figure 4.25: Nombuso's assessment on a visual representation

During reflection, teachers held the view that learners' responses were positive where visual representation was used.

Mr Gxaba:

> *Bringing manipulatives and VR in mathematics settings when word sums are taught, will give a clear picture to grade 4 learners.*

Miss Khathi:

> *Indeed, learners understand better when they have something tangible to associate word sums with for deeper understanding.*

With the help of pictures and clear understanding of the text, learners were able to do the calculations correctly and precisely. Teachers will have successful stories in enhancing problem-solving skills for grade 4 learners in solving word sums when using visual representations in their lesson presentations. Moreover, using the multiplicity of perspectival, theoretical and methodology of bricolage, and the PAR approach, grade 4 learners' problem-solving skills in word sums were enhanced.

4.6.4 Effects of learner attitude in the teaching and learning of word sums

A conducive learning environment determines a positive attitude towards learning. Furthermore, learners learn better in an environment where the teacher is friendly towards learners, and does not appear as a beast that learners should fear during the teaching and learning process. However, teachers should create an atmosphere that takes into consideration diversity and inclusivity (DBE, 2012:5), where learners feel

free and happy to express themselves (cf. 2.4.4.4) for the attainment of positive results in their learning. Less able learners feel intimidated in situations where teachers utter derogatory words when they don't assimilate the concept in the same pace as other learners. This then creates a negative attitude of learners towards their learning of word sums and the whole idea of mathematics. Learner attitudes towards the learning of word sums is pre-determined by the attitude of the teacher. A teacher's positive attitude towards the teaching of word sums will lead to learners' positive attitude towards learning word sums. Furthermore, rhymes in a mathematics classroom stimulate a positive attitude towards learning, because they are used as ice breakers that draw learners' attention. Therefore, creation of a conducive learning environment in a mathematics setting will bring positive attitudes towards the learning of word sums and learners' problem-solving skills will be enhanced.

In a grade 4B class Mr Gxaba drew a table below on the front of the classroom. He stepped out of the class and threw a rubber into the drawn table. The rubber landed on number 30. He then asked learners to double the number the rubber landed on.

Mr Gxaba*: Double the number the rubber landed on.*

Learners*: 60 (in unison)*

Mr Gxaba: *Good. I will throw it again and please half the number the rubber will land on.*

The rubber landed on 400 and the learners shouted 200.The game continued four times, 2times for doubling and the other 2 for halving. Mr Gxaba continued and said:

10	20	30	40
50	150	180	220
260	400	500	120

Figure 4.26: Square board

Mr Gxaba: *A mother dog weighs 600kg. If her 5year old baby weighs half the mother weight, how much weight would the baby dog have?*

Zekhethelo: *3000kg*

During the information session, the deputy principal commented as follows:

Deputy Principal (Mrs Deyi):

> *Mr Gxaba's presentation was interesting. Learners were very actively involved, it seemed they enjoyed the lesson.*

Principal:

> *I never imagined that playing games stimulates a positive learner attitude in a mathematics classroom. If teachers could adopt Mr Gxaba's approach to teaching word sums, all learners would not encounter problems in solving word sums.*

Sipho*:*

> *I enjoy playing games when we are learning mathematics. I wish the game could never end.*

Thando:

> *We learn better when we are not shouted at. We enjoy learning while we play, because we are free to express ourselves.*

All members of the research team agreed that indeed the attitude of learners in a mathematics classroom matters, for attaining positive results in problem-solving activities. However, teachers are role players in creating environments where learners will be motivated into doing better every time word sums are taught in the classroom. In so doing, grade 4 learners' problem-solving skills will be enhanced.

4.7 CHAPTER SUMMARY

This chapter focused on how the data were presented, analysed, interpreted and discussed. This was done in line with the objectives of the study, which are outlined in chapter one. Through the presented data, challenges facing grade 4 learners in solving word sums and solutions to those problems, were identified. Even though solutions were identified, grade 4 learners are struggling with word sums. Conditions and threats to the successful implementation of the strategy, as well as the indicators of success were also discussed. Evidence towards the successful implementation of the strategy to enhance grade 4 learners' problem-solving skills was presented. However, not all learners benefited from generated data. Seemingly, after all the endeavours teachers have made in enhancing grade 4 learners' problem-solving

skills, there are grade 4 learners who struggle with word sums even to date. The next chapter discusses the findings and recommendations for future use.

CHAPTER 5 :
FINDINGS AND RECOMMENDATIONS

5.1 INTRODUCTION

The aim of the study was to enhance grade 4 learners' problem-solving skills in word sums. The chapter begins with the background of the study, which encompasses the statement problem and the objectives of the study as they were sketched out in chapter one. The chapter also discusses the summary of literature review and the lens under which the study is guided. Research design and methodology will be discussed, data presentation, analysis and interpretation and lastly the findings and recommendations for future use.

5.2 BACKGROUND AND PROBLEM STATEMENT

The study aimed at designing a strategy to enhance grade 4 learners' problem-solving skills in word sums. Grade 4 learners have difficulties in understanding the text and solving word sums, because of the transformation from being taught in mother tongue in the lower grades to being taught in English in the intermediate phase. However, a strategy to assist teachers in their endeavour to enhance problem-solving skills for the grade fours was designed and put in place in a number of activities. The main purpose of the study is to respond to the research question of the study*: How can we enhance grade 4 learners' problem-solving skills in solving word sums.* To address this research question, the objectives to guide the study were formulated. They are:

1. To investigate the challenges facing grade 4 learners in solving word sums.
2. To analyse the strategy that will be used to improve grade 4 learner's problem-solving skills in word sums.
3. To identify conditions for the successful implementation of the strategy in enhancing grade 4 learners' problem-solving skills in word sums.
4. To anticipate possible threats that may hinder the implementation of the strategy to enhance grade 4 learners' problem-solving skills in word sums.

5. To identify the indicators for evaluating the success in the implementation of the strategy that has been used to enhance grade 4 learners' problem-solving skills in word sums.

5.3 SUMMARY OF THE STUDY

The study sought to formulate the strategy to enhance mathematics for grade 4 learners' problem-solving skills in solving word sums. The reason for doing the research was that there is high failure rate in mathematics in grade 4 learners, therefore the researcher felt that there is a need to find out the reasons why learners in this grade are failing mathematics. The idea was sold to all the people who would participate in the study and consent letters were issued. Participants to the study were mathematics teachers, the SMT, SGB members, and learners who were the target group. The research team to steer the entire process was established and the roles were clearly defined.

The theoretical framework that guided the study is bricolage. It was defined and explained in chapter two by the researchers (Kincheloe, 2005:323, Ball, 2009:82, Kincheloe & MacLaren, 2005:316, Mahlomaholo, 2013:387) and why it was suitable for the study. This theoretical framework was used in line with the objectives of the study, furthermore, the eight moments of a qualitative research were also introduced in chapter two and were infused with literature review. Operational concepts were explained, the formats of the theoretical framework, the types of bricoleurs, the rhetoric which is the kind of language spoken when the study is being conducted. In the study participants are referred to as co-researchers not subjects, and they are treated as equals in the study and their opinions are listened to and taken into consideration.

Research methodology that was used in the study in chapter three is PAR, which is defined by Denzin and Lincoln (2008:277) as a social process of collaborative learning and by Kemmis and McTaggart (2007:281). The objectives of PAR, formats, epistemology, ontology, stages of PAR, and relevance of PAR in the study were all discussed, as data were generated in a number of planned activities during lesson observations, meetings, discussions, etc., in line with the objectives of the study. Critical Discourse Analysis (CDA) was used during data analysis, presentation and interpretation in chapter four where the strategy to enhance grade 4 learners' problem-

solving skills in word sums was put to practice. The indicators of success in the usage of the strategy showed that grade 4 learners will improve their performance in mathematics when co-operative learning is applied in the learning environment, with the usage of visual representation, team-teaching and code-switching.

5.4 FINDINGS ON THE CHALLENGES WHEN THE STRATEGY TO ENHANCE PROBLEM-SOLVING SKILLS FOR GRADE FOUR LEARNERS WAS IMPLEMENTED

5.4.1 Lack of understanding mathematical language

It was clear that the lesson presented was not thoroughly prepared or it was not prepared at all. First and foremost, the teacher did not bring along the Learning and Teaching Material (LTM) during his presentation. He simply drew the picture of a cow and started asking learners questions. Looking at the learners' responses, it shows that learners had difficulty understanding what was expected of them to do. Learners answered questions based on the picture that they saw on the chalkboard. Questions were about six cows yet learners could see only one cow, thus the question was not clear enough for learners to understand. One can assume that learners did not notice that their answers should be based on six cows. The teacher could at least have brought a chart with six cows for learners to be able to give correct answers. To the researcher it appears like the teacher did not do enough to help learners conceptualise mathematical language. Had learners seen six cows on the chalkboard or on a chart, they would be able to get answers correctly. Teachers should refrain from assumptions and consider teaching learners from the known to the unknown. Learners' prior knowledge should be considered by teachers when teaching and building on it.

5.4.1.1 Recommendations on lack of understanding mathematical language

The study recommends that teachers should come to mathematics classrooms fully prepared. They should use the language that the learners comprehend better in clarifying the questions. Where learners don't understand in how to answer the question, scaffolding needs to be done by the teacher. Teaching from the known to the unknown is the approach teachers can adopt, in order to enhance problem-solving

skills for grade 4 learners. For instance, in the case where learners were asked about the body parts of six cows, the teacher was supposed to ask learners to identify body parts for the cow that was drawn on the board first, before moving to the unknown, which is six cows. Learners then would have known that they needed to count the six cows after they had counted the body parts of one cow first. This meant that the question was not clear enough to the learners.

5.4.2 Inability to relate mathematical language and English as LoLT

The grade 4s at the school where the study was conducted are learning mathematics in English for the first time, therefore, to them understanding mathematical language is challenging so that they answer questions without comprehension of the text. Looking at learners' assessments, it is clear that these learners did not understand the text and ended up answering questions in a way that pleased them. They were not familiar with the language used, they had not mastered mathematical concepts and ended up getting wrong answers to the questions. When learners put any kind of operation besides the one that is relevant to the problem, it only means they failed to relate mathematical language and LoLT. Inability to relate mathematical language meant that learners did not know whether to add, subtract, divide or multiply in order to solve the problem.

5.4.2.1 Recommendations on inability to relate mathematical language and English

Teachers should try by all means to give as many examples as possible to familiarise grade 4 learners with mathematical language (Mokotjo, 2017:172) for them to improve on their problem-solving skills in solving word sums. The grade 4s are the beginners in the intermediate phase, therefore scaffolding and guiding them towards getting the answers correct is a pre-requisite for the grade 4 learners. Teachers need to simplify the LoLT (Essien, 2013:8) as much as possible and provide as much vocabulary that will be in line with mathematical language. Inability to relate mathematical language and LoLT means that grade 4 learners' problem-solving skills will not be enhanced. Looking at the learners' assessment, it is imperative that teachers need to do as many

informal tasks that will prepare learners for the formal tasks at the end of each term. When learners' levels of performance are below average that means teachers still have a lot to do in enhancing grade 4 learners' problem-solving skills in word sums.

5.4.3 Using outdated teaching practices in a mathematics classroom

The aim of the curriculum is to ensure that learners acquire as much knowledge and skills as possible that they will be able to use it in real life situations (DBE, 2012:4). Teachers are therefore agents of realising this goal by employing various approaches and methods to teaching of the content. To be able to succeed in their endeavour, they should be properly trained and be exposed to as many programs as possible that will equip them with knowledge and skills they will use when teaching their learners in the learning environment. Findings revealed that some of the colleagues were not innovative in their presentations, they used the old approaches, which did not enhance learners' problem-solving skills. Telling learners what the lesson is about and how they should go about doing that, does apply in the implementation of the CAPS curriculum. Teacher-centred approaches deprive learners from opportunities of finding solutions themselves to the problems. Teachers need not tell learners what they should do with the problem in mathematics classrooms. This was evident in one of the lesson presentations where a teacher told learners to multiply in order to solve the problem.

5.4.3.1 Recommendations on using outdated teaching practices

Teachers should give as many examples as possible to make their teaching meaningful, and engage learners in activities that will be more learner-centred. Informing learners what the lesson is about does not help learners with the knowledge and skills they need when such an exercise has not been done previously. This contradicts with what Malebese (2016:172) mentioned when she said learning is constructed through building on what learners already know to that what they should know. Guiding learners with the examples during teaching, is what enhances their problem-solving skills more than just telling them what they should do in a mathematics classroom. In activities where learners were actively engaged in their learning, their self-confidence was enhanced and so was their problem-solving skills.

5.4.4 Inaccessibility of Pedagogical Content Knowledge

During the discussions, the research team pointed out that teachers without PCK do not follow the policy when teaching, but they assume that learners know something when they actually do not. Teachers who did not receive formal training in how mathematics should be taught, experience problems when teaching the subject. Commanding learners to do an exercise in the workbook without considering their prior knowledge was not a good call; only at the end of the lesson would that activity be completed to check whether learners understood the lesson taught. The DBE (2012:8) mentions that teaching and learning of mathematics aim at equipping learners with knowledge and skills they will be able to use socially in life and in solving mathematical problems. This then will be achieved when teachers themselves are fully equipped with knowledge and skills they will be able to convey to leaners in a meaningful and accepted manner. Learners cannot learn to solve word sums without guidance from the teachers. Telling learners to open a workbook and order them to write an exercise in it meant that the teacher did not plan his/her lesson. This meant that the teacher lacked PCK and needed support on how to go about when teaching learners.

5.4.4.1 Recommendations on inaccessibility of Pedagogical Content Knowledge

The study recommends that teachers should prepare their lessons thoroughly before presenting them to learners. This means that they should, at all times follow the policy when planning their activities. This is because the policy has guidelines to be followed and suggested resources to be utilised in designing activities for learners. Having PCK means that teachers should know what content they teach learners, what methods and approaches they should use, should one does not succeed in enhancing problem-solving skills and what resources are relevant for a specific topic. The study also recommends that teachers should be flexible and utilise as many theories as possible to make learning easy and to enhance problem-solving skills for grade 4 learners.

5.5 FINDINGS ON THE COMPONENTS TO FORMULATING A STRATEGY TO ENHANCE PROBLEM-SOLVING SKILLS IN WORD SUMS FOR GRADE 4 LEARNERS

This section focuses on the solutions pertaining to the challenges that were identified earlier on.

5.5.1 Impact of integrating mathematical language and vernacular in a mathematics classroom

Looking at the learners' scripts before code-switching was used, it is clear that these learners did struggle in understanding word sums. Some learners came up with big numbers when the sum only presented two-digit numbers. Other learners did not know which operation to use in a sum; they just put in whatever sign came into their minds. This then showed that they failed to conceptualise the mathematical text and deduce from it. After code switching to leaners' mother tongue, learners started performing well, because they understood clearly what was expected of them. Setati *et al.* (2009) concur that code-switching can be used not to teach learners, but only to explain what leaners don't understand in the LoLT. Code-switching is one of the approaches teachers can use in a mathematics classroom for better understanding and enhancement of problem-solving skills in solving word sums. Research has revealed that results improved in schools where code-switching was used.

5.5.1.1 Recommendations on impact of integrating mathematical language and vernacular in mathematics classroom

The study recommends that it is imperative that mathematics teachers integrate mathematical language and vernacular languages during the teaching and learning of word sums, especially when keywords are to be emphasised. This does not necessarily mean that learners are taught in their mother tongue, but it is used to clarify keywords only. This should be done with an aim of fostering grade 4 learners' mathematical thinking, as they are introduced to being taught mathematics in English for the first time. Grade 4 learners need to be familiarised with mathematical language in explaining difficult words, hence infusion of their mother tongue. Switching to

learners' mother tongue in the teaching of word sums help learners understand key words in the text and allows them to choose a suitable equation, in order to solve the posed problem.

5.5.2 Effective strategy in nurturing learners' mathematical thinking

Teachers have many roles to play and they are stipulated in the ELRC document (DBE, 2000:6-15). Amongst these roles are creation of a positive learning environment where learners will feel free to interact with the teachers, as well as their peers in a positive way. This was evident when learners were excited during the time when they were sorting the counters according to their colours and counted them. In this activity learners learnt through playing. Every learner participating enjoyed the game and this activity enhanced learners' attitude and their thinking towards learning of mathematics. Learners' mathematical thinking is not nurtured by playing games only, but by exposing them to as many activities that stimulate their critical thinking. Such activities help them enhance their self- esteem and allow them freedom to own their learning. Most learners wished mathematics could be taught in that manner for them to be able to understand word sums.

5.5.2.1 Recommendations on effective strategy in nurturing mathematical thinking

The study recommends that active learning should be practised in mathematics classrooms. This is the platform where learners are exposed to activities that allow them to be "hands-on". In active learning strategies, teachers are allowing learners opportunities to explore their potential. Learners' mathematical thinking is fostered as they engage themselves in activities like playing of games, such as Morabaraba, playing of cards and sorting counters. These games stimulate learners' interest of playing the games, while on the other hand they develop their level of thinking, which is empirical in solving word sums.

5.5.3 Effective usage of innovative teaching practices in enhancing problem-solving skills in mathematics

The research team, during their discussions concurred that the more learners were engaged in writing activities, the more their performance improved. Giving more activities for learners to write in a mathematics classroom is a pre-requisite, because learners get to see where their mistakes are and teachers get an opportunity of giving feedback in a form of corrections. Bicer, Capraro and Capraro (2013:363) supported the idea of letting learners keep a journal in a mathematics classroom, because teachers get to see where learners are lacking and they design a turn-around to assist learners who are struggling. Keeping a journal also helps learners correct their mistakes and enables them to consolidate the work they know with the newly learnt work. Keeping of a journal helps teachers to monitor learner progress so that they will be able to identify areas that need special attention. Writing on a journal helps parents interact with their children when helping them with their homework, and get to see whether their children are improving in mathematics. Blease (2014:38) attests that written tasks give teachers direction of checking whether learners are able to apply knowledge and skills learnt before attempting another topic. Learners' assessments in 4.3.3 are an indication that learners' problem-solving skills improved after they have been engaged in dozens of writing practices.

5.5.3.1 Recommendations on effective usage of non-teaching practices

The study recommends that teachers should be creative and innovative when teaching word sums. This was evident in the activity where they were hands-on in sorting mathematical counters. Learner centred activities promote active learning and demote passive learning. What learners learn through playing, is stored in their long-term memory and is easily retrievable by learners. However, writing is essential in the learning of mathematics, in the sense that it gives learners a platform to put their thoughts into writing for future use. Writing enhances writing skill, which is the essence of problem-solving, because it develops logical thinking needed when following the rules and procedures of problem-solving. Learners' journals are kept for referral purposes and for teachers in monitoring progress in enhancing problem-solving.

5.5.4 Effectiveness of Pedagogical Content Knowledge through usage of visual representation

The utilisation of visual representation made it easy for learners in getting the sum correct. These come in pictures, diagrams and even physical objects teachers can make use of to assist learners and to enhance their problem-solving skills. Learners may find it hard to decide on which operation to use in solving word sums, but with the help of visual representation they see the light and they find answers thereafter. The effective usage of visual representation was apparent in one of the lessons that was presented by a member of the research team. In that lesson counters of different colours were used to assist learners getting the answers correct. During a lesson presentation where counters were used, learners did not only get answers right, but their self-esteem was positive as well. They enjoyed the lesson and owned their learning without fear of the research team. Even learners that were reluctant in participating in that lesson wished the lesson of the same pattern could be repeated so that they too, would partake. Sampled learners' work on indicators of success revealed that the visual representation enhanced their problem-solving skills in word sums.

5.5.5 Recommendations on effectiveness of PCK through usage of visual representation

Teachers should undergo training and attend workshops regularly, in order to be able to gain the knowledge, as well as the necessary skills, values and attitudes towards enhancing problem-skills for learners. The teaching of word sums enhances learners' problem-solving skills. The study recommends that teachers should know different methods to be able to thread knowledge into the minds of learners, using different theories and perspectives of bricolage. In addition, engaging learners in writing practices regularly, gives them the platform of exploring their potential, to follow rules and procedures and always reflect on their work for future use. Writing in mathematics classrooms is an essential tool in a sense that learners are able to mend their errors and learn from them (cf. 2.4.2.3). This calls for creativity on the part played by teachers, when designing activities for learners (cf. 2.4.2.4).

5.6 FINDINGS ON CONDITIONS CONDUCIVE TO THE ENHANCEMENT OF GRADE 4 LEARNERS' PROBLEM-SOLVING SKILLS IN WORD SUMS

This section discusses the conditions towards the successful implementation of the strategy to enhance problem-solving skills for grade 4 learners.

5.6.1 Factors contributed to the conditions of nurturing mathematical language

Mathematics teachers from the research team prepared lessons on different aspects of mathematics to enhance grade 4 learners' problem-solving skills. Team-teaching ensured oneness amongst the research team. It also developed the spirit of Ubuntu where everybody helped one another wherever possible. During the discussions, the team pointed out that not only learners benefitted from the activities that were planned and presented to them. Teachers benefited as well when other members of the team evaluated the activities presented to learners and they built on the comments and reworked on the comments and the recommendations. Team-teaching benefited teachers in more ways than it did learners, because various approaches, multiple methods and a range of approaches were used to instil knowledge, skills and values to grade 4 learners. Even teachers who lacked Pedagogical Content Knowledge improved on their expertise through this approach of team teaching. The team concurred that teachers should be emancipated on working as a team, in order to develop themselves so they will be able to enhance learners' problem-solving skills in solving word sums. Through team-teaching teachers got opportunities to mend their shortcomings and learners' attitudes changed as they adapted to the idea of being around the group of teachers who presented some interesting lessons.

5.6.1.1 Recommendations on factors contributing to the conditions of nurturing Mathematical language

The study recommends that teachers should use strategies that allow them to work as a team, in order to succeed in enhancing problem-solving skills for grade 4 learners in comprehending word sums (c.f. 4.4.1). Utilization of team-teaching is ideal in a manner that teachers bring their ideas and experiences together, in order to emancipate one another in the team. Team spirit is stimulated in team-teaching strategies, which is

also ideal in strengthening the individual's PCK. Through team-teaching the multiplicity of bricolage is enhanced, hence also the problem-solving skills of learners.

5.6.2 Conditions towards effective usage of group work and peer tutoring

In their discussions, the team commented on the sitting arrangement of learners. They recommended that learners must be arranged in groups and given a platform where they exercise freedom of sharing ideas through peer tutoring. Learners perform better when they tackle the problem in groups, than when they tackle it individually. This was evident in the activity where learners were using counters to solve a word problem. Learners did well in that activity, because they actively engaged themselves sharing until the problem was solved. Learners working alone end up not knowing what to do, because nobody assist them during teaching and learning, because the teacher is the one who dominates the learners, and by doing so, other learners get bored while listening passively. The team made it clear that in peer-tutoring learners feel free to actively interact with their peers, asking questions where they do not understand than passively listening to the dominating teacher. It is in group work and peer-tutoring that teachers actually discover the potential of each learner in their classrooms. Leadership skills are easily identified in group work and peer-tutoring activities, and that is why the team emphasized that these two approaches are used concurrently in the learning environment.

5.6.2.1 Recommendations on conditions of groupwork and peer tutoring

The study recommends that learners should be arranged in groups and allow capable learners to assist less able learners, instead of letting the talk and chalk method by the teachers, dominate the class. (c.f.4.4.2). Arranging learners in groups allow them freedom to engage actively in classroom activities instead of listening passively to teachers who dominate the setting. Peer tutoring allows capable learners to assist those who feel shy to face the teachers when they are to answer questions. Word sums are understood better when learners help one another in groups and peer tutoring.

5.6.3 Conditions to effective Pedagogical Content Knowledge

During the discussions, the research re-affirmed that the PCK infuses content knowledge with innovative methods, ensuring that what is being conveyed to learners complies with the prescribed curriculum (Bell *et al.*, 2003:3). Teachers need to thoroughly prepare their lessons before presenting them to learners. However, professional training is necessary for all teachers so they will acquire Mathematics Content Knowledge (MCK) and PCK for proficiency in mathematics. Teachers should have knowledge of mathematics, as well as techniques and different methods to teach that content, in order to realise the end goal. Effective Pedagogical Content Knowledge means that teachers are compliant in implementing the curriculum that ensures the acquisition of knowledge and skills learners will use in their lived experiences (DBE, 2012:4), locally, as well as globally. Effective Pedagogical Content Knowledge means that teachers should have a clear understanding of curriculum differentiation, being able to address the barriers to learning in well planned activities. Effective Pedagogical Content Knowledge means that teachers should use innovative methods that ensures active learning in a mathematics classroom. This was evident in an activity where learners were dominating, sorting the counters and adding them and the teacher was less active, but guided learners with instructions until the activity came to its end.

5.6.3.1 Recommendations on effective PCK

The study recommends that teachers should be creative and adopt innovative teaching practices, in order to enrich their PCK. Novice teachers should seek assistance from the experienced teachers on what methods work best in enhancing problem-solving skills for grade 4 learners in word sums. Not only methods, but skills, values and attitudes can be adopted from experienced teachers, in order to be proficient in teaching word sums.

5.6.4 Conditions that supported teacher's communication skills and attitudes towards mathematics

The way teachers speak to learners has an impact to their learning. When teachers speak in a positive manner during teaching and learning, learners gain confidence and ask questions where they do not understand. Likewise, when learners are spoken to in a harsh and unfriendly manner, learners get scared and choose to keep quiet even when they could not anticipate what have been taught. Findings revealed that some teachers failed to communicate with learners in ways that benefitted the learners, instead learners ended up with wrong answers. When communication lines are clear between teachers and learners that is when teachers allow learners the opportunity to explore their abilities freely in an environment that is dominated by learners. Another condition to the successful implementation of the strategy is teachers' attitudes towards mathematics. A positive mind-set towards the teaching of mathematics leads to positive learning of mathematics. Learners did not do well where teachers failed to do thorough lesson preparation before presenting them to learners. This is because teachers lack enthusiasm towards the subject, they did not give it their all in preparing for teaching the class. After several discussions with the research team, teachers' attitudes changed for the better and learners' performance improved.

5.6.5 Recommendations on conditions that supported teachers' communication skills and attitudes towards mathematics

The study recommends full participation by teachers and learners during the teaching and learning of word sums for the achievement of the objectives. The way teachers communicate with learners should stimulate interest in learners, in order for them to be able to adapt to mathematical language. Teachers should come to the learning environment with a positive attitude towards teaching word sums for the development of a positive attitude towards learning (cf. 4.4.4). Creation of a positive, conducive learning environment, using learner-centred approaches, promotes active learning and decreases passive learning in a learning environment. Working as a team in mathematics classrooms gives teachers a platform to share ideas on planning, choosing relevant and suitable resources and applying methods that will engage learners actively in classroom activities (cf. 4.4.)

5.7 HINDRANCES TOWARDS THE SUCCESSFUL IMPLEMENTATION OF THE STRATEGY

This section discusses the findings on threats that impeded the successful implementation of the strategy. Following are examples of anticipated threats.

5.7.1 Hindrances of insufficient resources

Resources play a very significant role in a learning environment. Teaching and Learning Material (TLM) is a necessity in a mathematics classroom. (c.f. 2.4.4.1) During the reflection sessions, the team pointed out that the unavailability of resource material hindered the effective implementation of the strategy. In classroom activities where tangible resources were not available for learners to use, learners battled to come up with correct answers to posed problems. Mathematics is difficult to learn in the absence of material resources, and teachers needed to take ample time to re-plan activities that required TLM for learners to understand (c.f.5.4.4) Re-planning of activities was needed, because learners failed to solve word sums without the support of learning material. After the pictures, diagrams and visual representation had been used, learners got answers correctly. Time constraints were also a hindrance to the success of the study, because time is a resource on its own, too much time was lost when activities were to be re-done until the end goal was reached. Should the school had sufficient funds, a lot of resources could have been bought, in order to enhance problem-solving skills for grade 4 learners, hence financial resources are important.

5.7.1.1 Recommendations on hindrances of insufficient resource material

The study recommends that for effective teaching and learning to take place, teachers are encouraged to utilise as many resource materials as possible in mathematics classrooms to make learning easier and for problem-solving to be enhanced. Making use of pictures and other tangible objects allows learners to comprehend mathematical word sums. Absence of resource materials delays conceptualisation of word sums and a lot of time, as a resource is consumed when teachers have to re-plan where learners did not understand the content. Learners better when they associate things, therefore,

learning without resources is just boring for them and fruitless as their problem-solving skills are not enhanced in abstract teaching of word sums.

5.7.2 Hindrances of learner pace in assimilating mathematical concepts

Not all learners assimilate learning at the same pace. Some experience barriers along the way while others take too long to assimilate mathematical concepts in a learning environment (c.f.2.9.4). Less able learners struggled to finish the activities within the scheduled time, which disturbed the progress of the study. Learners not finishing activities within scheduled times slowed the process and teachers had to give extra time for them to finish given exercises. These learners were offered assistance from their peers, for peer tutoring to be utilised. Less able learners received intervention programme for them to be in line with their peers. For other learners, language barrier slowed the pace of conceptualising word sums. That is why learners' mother tongue was used to a certain extent.

5.7.2.1 Recommendations on hindrances of learner pace in assimilating mathematical concepts

The team made recommendations that teachers should not give too many exercises to grade 4 learners, because of their age. They are to be given a small amount of work that they will be able to finish within the scheduled period. The team concurred that less capable learners need to be given extra support, in order to enhance their problem-solving skills in word sums. It is for this reason that teachers have to execute as many methods and approaches as possible, until all learners are able solve mathematical word sums without difficulties. Bringing indigenous games in the learning environment to assist learners with difficulties in mastering word sums, is another approach mathematics teachers can employ, in order to enhance learners' problem-solving skills. Introducing games in a mathematics classroom will not only enhance problem-solving skills, but will also change the attitudes of learners towards mathematics as a subject.

5.7.3 Hindrances of inaccessible Pedagogical Content Knowledge

Pedagogical Content Knowledge comprises of knowledge of facts about a subject, theories, approaches, and resources to be used in teaching that subject (c.f.2.9.1.4). Policies have been designed and put to practice with an aim of producing well-skilled and knowledgeable learners in the entire universe. It is for this reason that teachers are well trained, in order to be able to impart knowledge and skills that will benefit learners. Teachers need to have knowledge of mathematics, because it is this knowledge that will assist to establish mental calculations that will stir learners' logic and critical thinking, as well as their problem-solving (DBE, 2012:8). The teaching and learning of mathematics intend to develop individuals with knowledge and skills to be utilised in social and physical contexts. When teachers fail to choose which TLM to suit a particular topic, this means that such teachers have little knowledge of the subject. This was evident in one of the activities where one teacher told learners that they will be learning multiplication, this act deprived learners opportunity to find deduce what was happening in that activity. Teaching learners from the known to the unknown and teaching them from simpler to the complex will be an assurance that teachers have a love for the subject and also that they have the SCK. Where learners were told to write an exercise in the workbook without clarification of what was expected of them, was a cry of the team and it only meant that teachers who failed to infuse the TLM into the content of mathematics, lacked PCK and SCK of mathematics.

5.7.3.1 Recommendations on hindrances of insufficient PCK

The study recommends that teachers need to have the Content Knowledge of mathematics and have PCK in order to be able to teach mathematics efficiently and effectively. Teachers need to be creative and design activities that are learner-centred and that engage learners actively, instead of letting them be seated quietly, listening to a dominating teacher in front of learners. Learners should be given a platform where they are able to explore their potential and making something meaningful of it, in order to enhance problem-solving skills. Teachers should make the learning environment conducive to learning by allowing learners to take charge of their learning, but allowing teachers to act as facilitators of the programme. In doing so, learners' problem-solving skills will be enhanced.

5.7.4 Hindrances of misconceptions towards the teaching and learning of word sums

It was noted that learners who struggled in getting answers correctly all the time showed signs of resenting the subject. These learners did not participate in group discussions and were not attentive during peer tutoring. They felt that just because they had nothing to share in groups, only capable learners should interact with one another. These learners ended up not learning what was intended at all. These learners lost hope of ever knowing mathematics. Whenever they were asked questions, they showed no passion and ended up not concentrating during teaching and learning. These learners were even laughed at by their peers during teaching when questions were asked. Teachers had to step in, in order to protect less capable ones from being ridiculed. This crippled these learners as their self-esteem was dented and they wanted nothing to do with group work and peer-tutoring. This kind of behaviour threatened the study, but teachers ensured learners that they were all equally important and that every member in the team can learn something from one another, even if it is not mathematics subject, but morals and values also. This led to conclusion that, as family members, we do not laugh at each other, but we assist and empower one other for the better.

5.7.5 Recommendations on hindrances of misconceptions towards the teaching and learning of word sums

The study recommends that teachers need to bring joy in mathematics classrooms by introducing indigenous games that inspire and stimulate learners' interests of learning word sums. Playing of games during learning suppresses shyness and develops confidence to learners who usually struggle in solving word sums. Most learners have a negative attitude towards learning word sums. However, letting learners play in mathematics classrooms during the teaching of word sums changes their attitude towards the subject. They also need to incorporate the resources that support the teaching and learning of mathematical word sums when planning their activities. In doing that they avoid the confusion that usually occurs when word sums are taught abstractly, which also contributes to learners' negative attitude towards learning word sums.

5.8 FINDINGS IN THE SUCCESSFUL IMPLEMENTATION OF THE STRATEGY TO ENHANCE PROBLEM-SOLVING SKILLS FOR GRADE 4 LEARNERS IN WORD SUMS

This section discusses the evidence in the successful implementation of the strategy to enhance grade 4 learners' problem-solving skills in solving word sums.

5.8.1 Nurturing Learners' mathematical thinking

Looking at the learner assessments, findings show that after learners had been familiarised with a number of activities where keywords and mathematical concepts were emphasized, their level of understanding improved and they got the sums right. This is an indication that teachers made efforts to ensure that learners were given extra support that enhanced their problem-solving skills. It also indicates that learners had a will to learn as well, because no matter how much efforts teachers can put in, when learners show no interest in learning, teachers' hard work go in vain. However, it is empirical that learners understand the content first before they are assessed on it for the attainment of good results. In activities where learners showed that they had no comprehension of the concepts, they performed poorly. It took a lot of patience and diligence on the teachers' part to instil knowledge and skills that ended up enhancing the grade 4 learners' problem-solving skills. Emphasis on keywords in a text is what helped teachers nurture learners mathematical thinking (c.f. 2.9.2.1 and 4.6.1). If learners' mathematical thinking is not developed, learners get confused and end up having misconceptions. Underlining of the words, which are key to the solving of word sums played a big role in assisting learners to solve the word sums.

Teachers also resorted to code-switching in an endeavour to enhance grade 4 learners' problem-solving skills. This approach made it possible for all learners to understand what was expected of them. Even less capable learners benefited when teachers explained some keywords in their mother tongue, because they ended up getting clarity on how they had to approach the word sums. This switching of the codes was one way of nurturing the grade 4 learners' mathematical thinking in solving word sums.

5.8.1.1 Recommendations on nurturing learners' mathematical thinking

The study recommends that teachers should develop as many activities as they can in simple language, in order to foster mathematical thinking in grade 4 learners' minds. They should not use mathematical texts that are too long in nurturing learners' mathematical thinking. It is empirical for teachers to emphasize the noting of keywords in a text for learners' better understanding and problem-solving. They can use whatever learning material at their disposal to enhance grade 4 learners' problem-solving in word sums, for instance telling of short stories, in order to enhance their mathematical thinking before they solve the problem.

5.8.2 Writing practices enhance learners' problem-solving skills

Counting is a pre-requisite in a mathematics classroom. Learners need to be developed in counting skills before they are taught how to write the sums. Findings revealed that this skill was developed by one member in the research team where learners collected counters and counted them in a form of a played game. This activity created a positive attitude towards the learning of mathematics. However, teachers need to create an environment where learners are engaged in writing activities (c.f.2.9.2.3). To succeed in that they need to model it to learners and show them the right way by demonstrating how to go about doing calculations in a mathematics classroom, because mathematics cannot be learnt abstractly. Learners need to develop writing skills at school so that they will be able to do their homework by themselves. The more learners are engaged in writing activities, the more writing skills they acquire, which will enhance their problem-solving skills. Learners get to correct their mistakes after feedback has been given by teachers and this written work helps for future referencing. However, keeping of a journal (c.f.4.3.2) also helps teachers to monitor learner progress and to mitigate the deficiencies in learner performances. Evidence of learner assessments indicated that the more learners were engaged in writing activities, the more their problem-solving skills were enhanced and so was their performance.

5.8.2.1 Recommendations on writing practices

The study recommends that learners should be engaged in writing activities by keeping a workbook in which to do their daily activities, because writing is a powerful tool teacher need to use to monitor learners' progress in the mathematics classroom. Teaching learners mathematics abstractly deprives learners the opportunities to explore different ways of acquiring knowledge and skills they need for problem-solving. However, teachers need to allow learners freedom to engage in writing practices so that they will be able to amend their mistakes when solving word sums.

5.8.3 Accessible Pedagogical Content Knowledge in the teaching and learning of word sums

Mathematics is not an easy subject for all learners to understand. Some of the concepts are easy to teach and learners do not encounter problems in understanding them. Other concepts are difficult for learners to comprehend, word sums in particular. In order to assist learners conceptualise word sums, teachers themselves need to be well trained on the subject They need to have knowledge of the subject where they have acquired as many skills and methods of how to approach a specific concept in teaching learners (Kahan, Cooper & Bethea, 2003:223). During data analysis in the previous chapter, it was evident that some of the teachers lack or had little knowledge on addressing the challenge of word sums learners have. They came to class with little and incomplete preparations to teach learners. This was witnessed in one of the lesson presentations where one of the co-researchers told learners what they needed with the problem that was posed, instead of guiding them with the use of scaffolders towards the correct answer (cf. 4.2.1.3). The approach he used did not enhance learners' problem-solving skills in addressing the problem. This showed that he lacked pedagogy of teaching the concept he wanted learners to know (cf. 4.2.1.4). Giving learners classwork without giving clear instructions, is also not the correct way of enhancing their problem-solving skills and it was opposed by former researchers (cf. 3.2.3), because it deprives learners of exploring their strengths and potential (Mahlomaholo, 2013:387). In conclusion, for successful enhancement of learners' problem-solving skills in word sums, teachers need to have sufficient Pedagogical Content Knowledge and subject content knowledge.

5.8.3.1 Recommendations on accessible PCK in the teaching and learning of word sums

The study recommends that teachers do need to tell learners the answer to the problem, but should let learners find ways of arriving to the answer themselves. Guiding learners with questions during problem-solving is what teachers can do which serves as scaffolding learning. Finding answers themselves is what enhances learners' problem-solving better than merely being told what to write by teachers. Teachers can only use a variety of perspectives and innovative ways in trying to direct learners towards the answers. Such innovative approaches are learner-centred approaches.

5.8.4 Usage of visual representation in a mathematics classroom

Counters are concrete objects teachers use to make their teaching easier in a mathematics classroom. All tangible objects, pictures, charts and other visual representations assist teachers as manipulatives that make learning easier (Mokotjo, 2017:147). During the discussions, the research team pointed out that where teachers used the visual representation, learning became easier for learners. Not only less capable learners benefit from the usage of visual representation, but all learners in a learning environment. Where manipulatives are used, learners grow the love of mathematics, because while they learn they play as well. The research team also noted that learners get excited when they are exposed to activities where they compete against one another, individually or collectively. Furthermore, learners feel happy when they are in the winning group, because their success is calculated on the efforts of a group, not of an individual person. Usage of pictures and diagrams tones up a deeper understanding of concepts in a mathematics class, because what has been learnt through the usage of visual representation, learners do not forget easily. Learners enjoyed to be in the environment where they were free to express themselves in the way they knew how, and which was meaningful to them. Learners also learnt to share responsibilities and gave one another a chance to participate in group activities. A conducive learning environment is where learners feel free to display their potential and gain new skills to expand it

5.8.4.1 Recommendations on the usage of Visual Representation

The study recommends that teachers should make use of visual representation and manipulatives in mathematics classrooms. These manipulatives include pictures, drawings, tangible objects and mathematical instruments, in order to succeed in enhancing grade 4 learners' problem-solving skills in word sums. This helps even when learners have no idea or little understanding of what is expected of them. With the help of looking at the visual representations they get a clearer picture of how to go about solving the problem. That is why using of the vernacular in mathematics classrooms should be minimal. Using English for communicating increases learners' level of acquiring the vocabulary they need, in order to understand word sums.

The study also recommends that extra support should be given to learners, especially less able ones so that parents are involved in their children's' learning. Some parents are not aware that their children have challenges in the learning of mathematics as a whole. However, emancipating parents on the issues of teaching and learning mathematics will assist the situation. Some parents have this naive perception that mathematics is a difficult subject and that not every child can master mathematics. It is for this reason that parents should be emancipated as well, in order to erase this stereotypical idea about learning of mathematics. They should involve themselves by helping out with homework as a means of supporting learners in problem-solving activities.

5.9 LIMITATIONS OF THE STUDY

The research was likely to come to an end, and so it did. Not everything planned went accordingly though. Seemingly, along the way were limitations to the study, which included co-researchers not committing fully to the study. This was evident in activities where they did not prepare their lessons thoroughly for learners to understand and apply knowledge on word sums. This then slowed the pace of the study. Another contributing factor was that teachers were complaining of the time they spent preparing for the study, saying the latter consumed most of their time, because they had to use their afternoons and weekends for the study. Another limitation was financial resources as the study was not funded. All the co-researchers had to be

transported to their residents, as they live far from school. This also slowed the process, because the study was conducted twice a month to lower the costs.

Less capable learners took too long to complete given tasks and ended up consuming a lot of time and this also slowed the pace of the study. The co-researchers were not so patient with the learners taking too long to finish the tasks. They sometimes lost their temper towards learners for not getting work done in an agreed schedule. The parent component did not attend most of the reflection sessions and the reasons they forwarded were that they knew nothing about mathematics and they felt they could not contribute anything during discussions. They felt that their presence was meaningless, however that was not the case. They were reassured that they were as important as all other co-researchers in the study.

5.10 CONTRIBUTIONS OF THE PRESENT STUDY

The study contributed to the learners of the grades 4, 5, 6and 7 within the school it was conducted. Teachers who participated in the research have better insight of how to teach word sums in their respective grades. Contributions of the study will continue to spread in local schools, provincial, national and even globally. Teachers who participated in the enquiry acquired as many theories, perspectives and methods under the bricolage model and the utilisation of PAR in attempt to enhance grade 4 learners'

5.11 RECOMMENDATIONS FOR FURTHER RESEARCH

The study was aimed at enhancing grade 4 learners' problem-solving skills in word sums. In pursuit of doing that, challenges facing teachers in the teaching of word sums were identified and solutions to those challenges were established. Sharing of ideas and opinions were done in a number of planned activities and during discussions by co-researchers. Amongst the solutions that were established, it was evident that not all learners will benefit from it. Some of the solutions will have challenges in them. Examples are that code-switching can never work in cases where teachers do not speak the same language as learners. Such a solution is not reliable and it cannot be taken as a solution to the problem.

Through writing practices, learners got to understand some of the concepts they learnt in solving word sums (Blease, 2014:22), because when learners use journals (Bicer, Capraro & Capraro, 2013:1) to write on, they are able to see their shortfall and strengths and work on their weaknesses. Teachers also get to monitor learner progress through written work. It is highly recommended for mathematics teachers to always make use of pictures, diagrams and visual representation whenever they teach word sums (Poch *et al.,* 2015:5), because young learners learn by associating things. However, seeing physical objects (Mokotjo, 2017:130) and utilising them in solving word sums will enhance their problem-solving skills. Reading also forms an integral part in a mathematics classroom, because learners cannot write something having not read and understood it first. It is for this reason that learners be engaged in reading activities so they will not encounter problems in understanding text in mathematical word sums.

5.12 SUMMARY OF THE STRATEGY TO ENHANCE GRADE 4 LEARNERS' PROBLEM-SOLVING SKILLS IN WORD SUMS

The aim of the study was to develop a strategy to enhance problem-solving skills for grade 4 learners in word sums. Many researchers across the globe have encountered problems with the teaching and learning of mathematical word sums. In their work, Bicer, Capraro and Capraro (2013) indicated that Filipino learners in the elementary grades had difficulties in comprehending word sums. The same problem was identified by MolokoMphale and Mhlauli (2014) in their work on the research that was conducted amongst grade 4 learners in Botswana. To date grade 4 learners in South African schools are still struggling in conceptualising word sums. The strategy was designed to address challenges teachers encounter during the teaching and learning of word sums in grade 4 classrooms. Following is the strategy that was designed as a means to address the problem of learners not conceptualising word sums in grade 4 classes. Below are the measures that were taken to formulate the strategy to enhance grade 4 learners' problem-solving skills.

5.12.1 Challenges to the framework to enhance problem-solving skills in word sums

Teachers experienced difficulties in teaching word sums to grade 4 learners using English as LoLT. The grade 4 learners are struggling to understand word sums in a language they were never taught before. They fail to use relevant equation in order to solve the problem. They cannot differentiate between addition, subtraction, multiplication and division problems. Even though they have acquired the English vocabulary, they still struggle with mathematical language in understanding the mathematical text. As a result, they fail to conceptualise word sums. Teachers end up finding ways to minimise the problem of misconception by learners, and come up with solutions to the problem.

5.12.2 Solutions to the framework to enhance problem-solving skills in word sums

In finding a solution to the problem, teachers used learners' mother tongue in striking the balance between English and mathematical language (Ahmad & Yusoff, 2009:49). Diverting to learners' mother tongue helped the teachers in emphasizing keywords (Meyer, 2014:7) for learners to be able to understand the text and to solve word sums. The teaching strategies and approaches teachers used, for instance, teacher-centred approaches also contributed to learners' misunderstanding of word sums. This is because teachers teach word sums abstractly, instead of engaging learners in activities where they are actively involved. Learner-centred activities stimulate interest in learning word sums (Van de Walle, 2004:32), in order to enhance problem-solving in grade 4 learners. Teachers need to refrain from ancient methods of teaching and be innovative and creative when teaching word sums. Learning by doing is the best method teachers can instil to grade 4 learners, in order to enhance their problem-solving skills. This approach allowed all learners to participate and to execute tasks with clear understanding. In designing learners' activities, teachers need to choose the TLM that is at the age level of learners to scaffold learning of word sums. Learners get a clear understanding of word sums where real objects, pictures and drawings are aligned with word sums (Berry, 2008:149)

5.12.3 Conditions to the framework to enhance problem-solving skills in word sums

Some of the solutions come with conditions. Conditions to the strategy are that the success of the study used team-teaching where teachers used their knowledge and skills in mathematics classrooms. A collective endeavour in the teaching and learning of word sums bears better results than when the challenge is addressed individually. Novice teachers learn from experienced teachers and vice versa. Cooperative and active learning in mathematics classrooms worked wonders because learners, even the less gifted, got to participate freely (Runyon, 2016:2) in hands-on activities. In teacher centred activities, learners are deprived of opportunities to explore their options and end up confused and resort to guessing the answers. This was witnessed in one lesson presentation where the teacher failed to use the learning material, he prepared for learners to solve the problem he posed. Grade 4 learners performed better in peer tutoring activities where they were arranged in small groups in solving word sums (Quirk, 2012:2).

5.12.4 Threats to the framework to enhance problem-solving skills in word sums

There are risk factors in every strategy that is designed to solve a problem. Shortage of resources hampered the smooth progress of the study. Some of the teachers did not prepare TLM that would enhance problem-solving skills for grade 4 learners. In such cases, learners' mathematical thinking was not fostered and learners ended up sitting passively without any hands-on activity that stimulated their interest in solving word sums (Pierce & Fox, 2012:106). For the success of the study, teachers need to choose TLM in a manner that will not confuse learners, but that will enhance their problem-solving skills. Time, as a resource, hampered the pace and the progress of the study, as learners were slow in conceptualising word sums. Other teachers presented unplanned activities and that showed a lack of PCK on their part (Kleickerman, 2013:95). Such activities needed re-planning so they could be used to enhance problem-solving for grade 4 learners.

5.12.5 Success of the framework to enhance problem-solving skills in word sums

Learners' problem-solving skills for grade 4 learners were enhanced in activities where manipulatives, and tangible objects were utilised (Rondina, 2014:327). This was evident in an activity where learners were actively involved in sorting the counters according to their colours. That activity was meant to enhance various skills, such as counting skills, sorting skills (DBE, 2011:18) and the pace at which they finished the activity. Success to that activity was that it focussed on learner' participation. Success of the framework was evident in activities where learners' mother tongue was used to take note of keywords in a text. Success of the framework was evident in learner-centred approaches where teachers used manipulatives (Khoza, 2016:100) and a wide range of approaches to teaching (Hurrel, 2013:55) to enhance learners' problem-solving skills.

5.13 CONCLUSION

The study was aimed at enhancing mathematics for grade 4 learners' problem-solving skills in solving word sums. In attempt to do this, challenges facing teachers in teaching word sums were identified and solutions to them were sought and implemented. Conditions conducive to the success of the study were anticipated, but there were hindrances that impeded the implementation of the strategy towards the success of the study. Bricolage was the theoretical framework that guided this study where the moments of qualitative research were discussed in reviewed literature. The strategy was implemented with the employment of PAR as research methodology in chapter three of the study.

Generated data was presented, analysed and interpreted in chapter four in a range of activities that were planned by co-researchers using CDA. Chapter five presented the findings of the study, limitations and recommendations for further research. Even when the study came to an end, the team felt that what transpired in the study was not enough, further research can be done to enhance problem-solving skills for the grade 4 learners in solving word sums.

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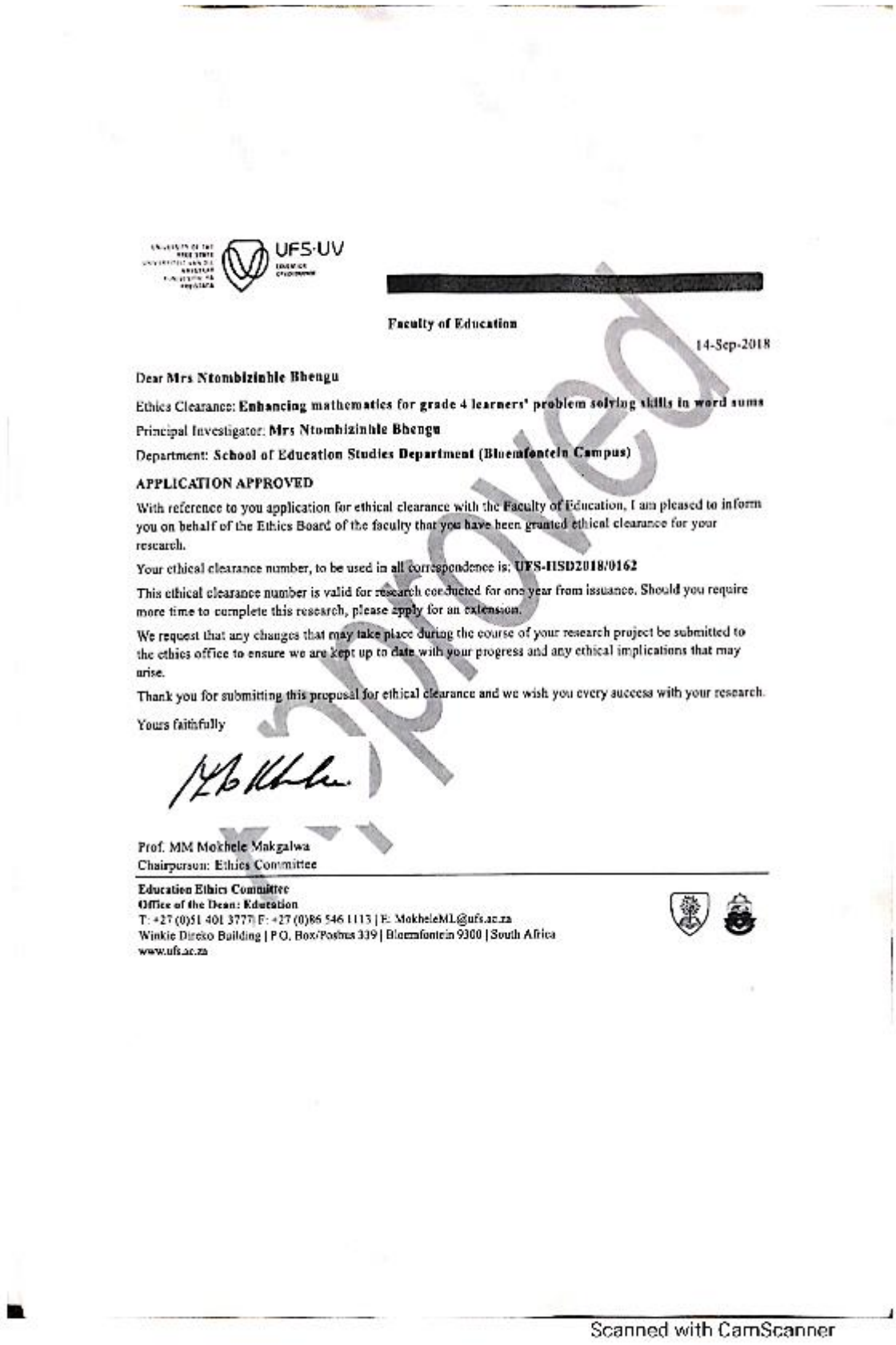
APPENDICES

APPENDIX A: ETHICS STATEMENT



UFS·UV

[redacted]

Faculty of Education

14-Sep-2018

Dear Mrs Ntombizinhle Bhengu

Ethics Clearance: **Enhancing mathematics for grade 4 learners' problem solving skills in word sums**

Principal Investigator: **Mrs Ntombizinhle Bhengu**

Department: **School of Education Studies Department (Bloemfontein Campus)**

APPLICATION APPROVED

With reference to you application for ethical clearance with the Faculty of Education, I am pleased to inform you on behalf of the Ethics Board of the faculty that you have been granted ethical clearance for your research.

Your ethical clearance number, to be used in all correspondence is: **UFS-HSD2018/0162**

This ethical clearance number is valid for research conducted for one year from issuance. Should you require more time to complete this research, please apply for an extension.

We request that any changes that may take place during the course of your research project be submitted to the ethics office to ensure we are kept up to date with your progress and any ethical implications that may arise.

Thank you for submitting this proposal for ethical clearance and we wish you every success with your research.

Yours faithfully

Prof. MM Mokhele Makgalwa
Chairperson: Ethics Committee

Education Ethics Committee
Office of the Dean: Education
T: +27 (0)51 401 3777 F: +27 (0)86 546 1113 | E: MokheleML@ufs.ac.za
Winkie Direko Building | P.O. Box/Posbus 339 | Bloemfontein 9300 | South Africa
www.ufs.ac.za

Approved

APPENDIX B: PERMISSION TO CONDUCT RESEARCH FROM KZN DoE

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma | Tel: 033 392 1041 | Ref. 2/4/8/1256

Mrs NR Bhengu
PO Box 82025
Osizweni
2952

Dear Mrs Bhengu

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"ENHANCING MATHEMATICS FOR GRADE FOUR LEARNERS' PROBLEM SOLVING SKILLS IN WORD SUMS"**, in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 03 July 2017 to 09 January 2019.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Connie Kahologile at the contact numbers below.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

Embabane Primary School

Dr. EV Nzama
Head of Department: Education
Date: 05 July 2017

..Championing Quality Education - Creating and Securing a Brighter Future

KWAZULU-NATAL DEPARTMENT OF EDUCATION
Postal Address: Private Bag X9137 • Pietermaritzburg • 3200 • Republic of South Africa
Physical Address: 247 Burger Street • Anton Lembede Building • Pietermaritzburg • 3201
Tel: +27 33 392 1004/41 • Fax: +27 033 392 1203 • Email: Kahologile.Connie@kzndoe.gov.za/Phindile.Duma@kzndoe.gov.za • Web: www.kzneducation.gov.za
Facebook: KZNDOE Twitter: @DBE_KZN Instagram: kzn_education Youtube: kznDoe

APPENDIX C: LETTER TO KZN DoE REQUESTING PERMISSION TO CONDUCT RESEARCH

Study Leader

Dr. J.T Moloi

Education Building

School of Education Studies

Qwaqwa UFS

Contacts: 082 202 5870

Email: moloijt@ufs.ac.za

Researcher

Ntombizinhle R Bhengu

P.O. BOX 82025

Osizweni

2952

Contacts: 082 589 0014

Email: bhenguzinhle9@gmail.com

Informed Consent

Education Stakeholder

I hereby request your consent in conducting this research study titled: **Enhancing mathematics for grade 4 learners' problem solving skills in word problems.** Statistics have revealed that learners in the intermediate phase are struggling in understanding some of the mathematical concepts, word sums in particular. The study therefore seeks to assist learners in the fourth grade to assimilate problem solving skills in mathematical language. Permission to conduct this study will also be sought from the SGB. Consent letters for learners who will participate will be given to parents, and invitations to co-researchers. However, their identities will remain confidential unless they wished they will be revealed at the end of the study.

Due to time constraints, actual dates for conducting the study are not inclusive in this letter but will be communicated at a later stage.

Thanking you in anticipation

Yours faithfully

APPENDIX D: INFORMED CONSENT

P.O. BOX

82025

Osizweni

2952

HOD/TEACHER

P.O.BOX 7421

Dannhauser

3080

Madam/Sir

Informed consent

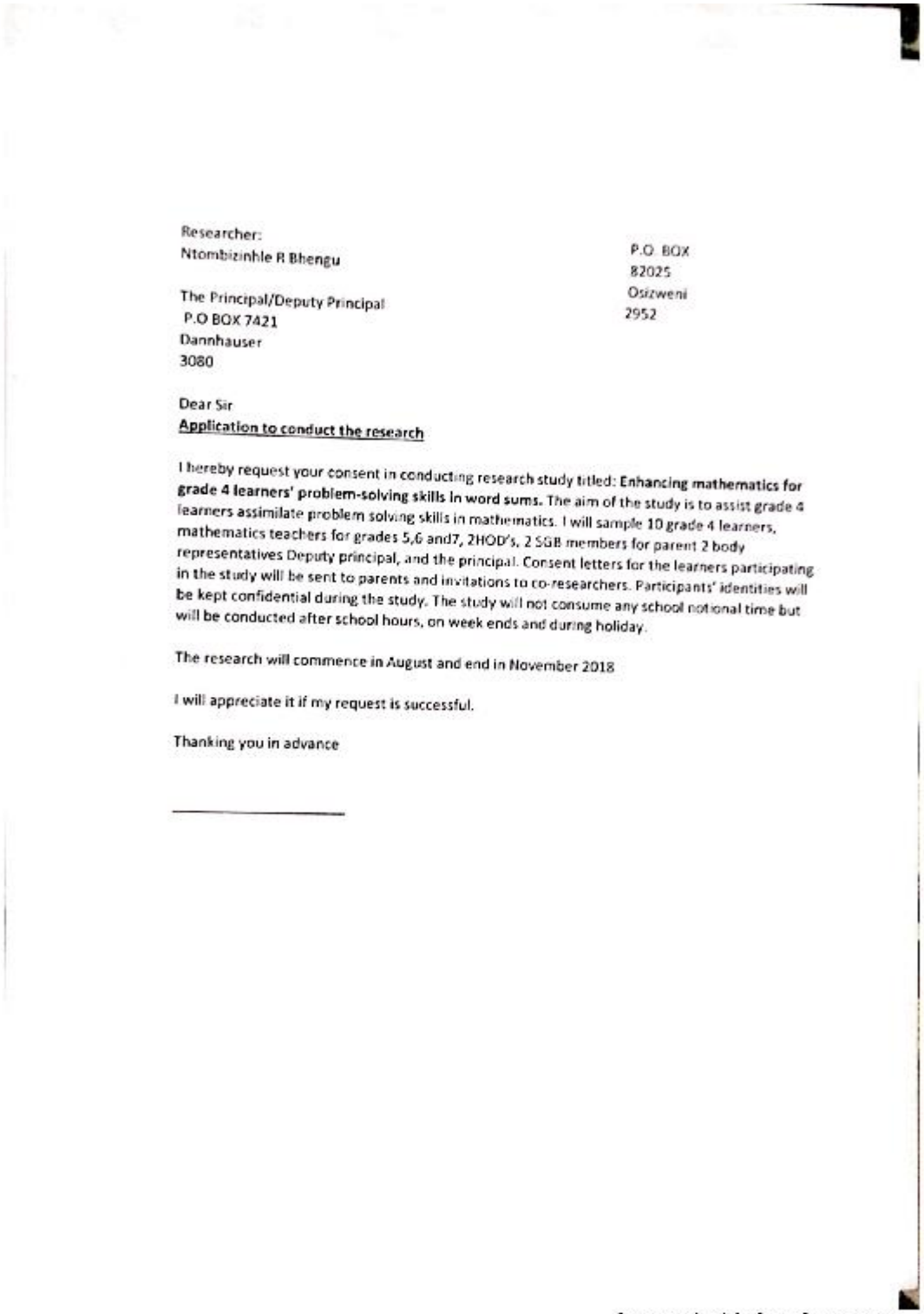
I hereby request your consent in participating in my study titled: **Enhancing mathematics for grade 4 learners' problem-solving skills in word sums.** The aim of the study is to assist grade 4 learners assimilate problem-solving skills in mathematics. The study will be conducted after school hours, on weekends and during school holidays.

Thanking you in advance

Yours sincerely

Ntombizinhle Bhengu

APPENDIX E: LETTER TO PRINCIPAL: APPLICATION TO CONDUCT RESEARCH



Researcher:
Ntombizinhle R Bhengu

P.O BOX
82025
Osizweni
2952

The Principal/Deputy Principal
P.O BOX 7421
Dannhauser
3080

Dear Sir

Application to conduct the research

I hereby request your consent in conducting research study titled: **Enhancing mathematics for grade 4 learners' problem-solving skills in word sums.** The aim of the study is to assist grade 4 learners assimilate problem solving skills in mathematics. I will sample 10 grade 4 learners, mathematics teachers for grades 5,6 and7, 2HOD's, 2 SGB members for parent 2 body representatives Deputy principal, and the principal. Consent letters for the learners participating in the study will be sent to parents and invitations to co-researchers. Participants' identities will be kept confidential during the study. The study will not consume any school notional time but will be conducted after school hours, on week ends and during holiday.

The research will commence in August and end in November 2018

I will appreciate it if my request is successful.

Thanking you in advance

_____

Scanned with CamScanner

APPENDIX F: LETTER TO PARENTS: CONSENT TO CONDUCT RESEARCH

P.O.BOX 82025

Contact: 082 589 0014

Osizweni

Email: bhenguzinhle9@gmail.com

Application for child's consent

Dear Parents

I, Ntombizinhle Bhengu, am conducting a research at my school with the grade 4 learners as it appears that they are underperforming in mathematics I therefore request permission to involve your child in the study. Learners will be taught on Saturdays and school holidays from October to December 2018. Your child's identity will be concealed during the study and will be revealed at the end of the study. Withdrawal of your child from participating in the study will be granted at any time you wish to do so. Costs for transportation during the study will be taken care of by the researcher.

Thanking you in anticipation

Yours faithfully

Mrs N. Bhengu

Kindly fill in the missing spaces below:

I _____ parent of _____ give consent for him/her to participate in the study.

Signature

_____

APPENDIX G: LANGUAGE EDITING CERTIFICATE

Michelle Woolley

WRITER EDITOR PROOFREADER TRANSLATOR

Associate Member of Professional EDITORS' Guild (PEG)

CERTIFICATE OF EDITING

This letter certifies that I have edited the dissertation / thesis / research proposal detailed below.

Title:

ENHANCING MATHEMATICS FOR GRADE 4 LEARNERS' PROBLEM-SOLVING SKILLS IN WORD SUMS

Author:

NTOMBIZINHLE ROSEMARY BHENGU

Regards
Michelle Woolley

Date: 25/07/2020

michellewoolley12@gmail.com
083 298 2077

Professional EDITORS Guild

APPENDIX H: TURN IT IN REPORT

turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Ntombizinhle Rosemary Bhengu
Assignment title:	Draft
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Page count:	168
Word count:	52,955
Character count:	287,640
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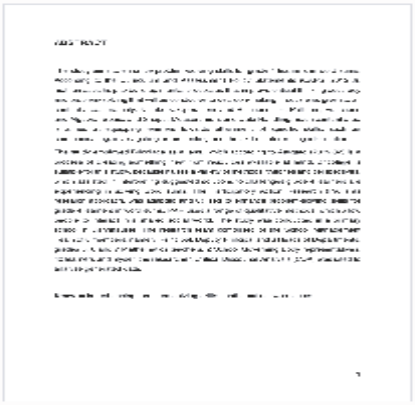

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