

THE CONTEXT-BASED IN TEACHING AND LEARNING OF COMMON FRACTIONS IN GRADE SEVEN

By

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DECLARATION

I hereby declare that this dissertation: The context-based approach in the teaching and learning of common fractions in grade seven is my work and all sources I used or cited have been acknowledged by means of complete references. I further declare that the work is submitted for the first time at the University/ faculty towards the purpose of obtaining a master's degree. I furthermore, cede copyright of the dissertation in favour of the University of the Free State.



Signature: _____

Date: _____ 31 JULY 2020 _____

DEDICATION

This work is dedicated to Mbhudi Luke Dakile (my late father),

Gladys Nomvula Dakile (Makhumalo) (my late mother)

I also dedicate this work to my husband, Siphon Nyembe for everlasting encouragement and support and our children Thokozane, Ntokozo and Snehlanhla Ntshingila.

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ABSTRACT

This study aimed to design the framework of teaching and learning of common fractions in Grade 7 by the use of a context-based approach. An Annual National Assessment (ANA) report released by the Department of Basic Education during 2012 indicated that learners were experiencing difficulties in fractions, in the lower levels up to the tertiary levels of the teaching and learning. The research focused on Grade 7.

It is for this apparent reason that the researcher aimed to design a framework of common fractions for Grade 7 learners. Bricolage is the lens. The reason for the choice of bricolage is to ensure that the context-based strategy is designed to enhance teaching and learning of common fractions and to achieve the research objectives, due to its multi-theoretical, multi-methodological and multi-perspectival qualities. Furthermore, the researcher employed participatory action research (PAR) as the research methodology. PAR encourages co-researchers to participate actively in the research process and encourages learners to be actively involved in the teaching and learning of common fractions in Grade 7. The researcher used critical discourse analysis to present, analyse and interpret data generated from the research field. Data was analysed through three lenses, namely the textual, discursive and social practice level. The findings of the research were used to formulate the framework of teaching and learning of common fractions in grade 7 using context-based approach.

I have found that the context-based strategy is a desirable way to improve the teaching and learning of common fractions in grade 7. I recommend the use of this approach in the pursuit for curriculum significance will assist all stakeholders within the DoE, such as learners, teachers and DoE.

Keywords: Context-based approach, Fractions

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LIST OF ACRONYMS

According to Early Assessment	(EAP)
Annual National Assessment	(ANA)
Australian Council of Deans of Education	(ACDE)
Concrete pictorial abstract	(CPA)
Content knowledge	(CK)
Critical Discourse Analysis	(CDA)
Curriculum and assessment policy statement	(CAPS)
Department of Basic Education	(DBE)
Early Assessment Programme	(EAP)
Free Attitude Interview	(FAI)
KwaZulu Natal	(KZN)
Lowest common denominator	(LCM)
Mathematics Learning and Teaching Initiative	(MALATI)
National Academies Press	(NAP)
National Assessment of Educational Progress	(NAEP)
National Council of Teachers of Mathematics	(NCTM)
Outcomes-based Education	(OBE)
Participatory Action Research	(PAR)
Pedagogical content knowledge	(PCK)

South Africa	(SA)
Southern African Development Community	(SADC)
Southern and Eastern African Consortium for Monitoring Educational Quality (SACMEQ)	
Systemic Functional Linguistics	(SFL)
Trends in International Mathematics and Science Study	(TIMSS)
United States of America	(USA)
Concrete-representational-abstract	(CRA)

1 CHAPTER ONE: LAYOUT OF THE STUDY.

1.1 INTRODUCTION

This study aimed to design the framework in teaching and learning of common fractions in Grade 7, using a context-based approach. A context-based approach is a process of using mathematical concepts and skills that are relevant to learners from diverse backgrounds in a real-life context (Falcao, Meira, & Gomes 2007:3). A fraction, as defined by Gabriel, Coché, Szucs, Carrette, Reysoul and Content, (2013:715), is referred to as a ratio, operator, quotient or measure. Brown and Quinn (2007:27) and Maharaj, Brijlal and Molebale (2007:598) further argue that it can also be a part of a whole, made up of a numerator and denominator. This chapter offers a background to the study, followed by a problem statement, which covers the research question, research aim and the objectives of the study. A theoretical framework, “bricolage”, is briefly outlined, followed by operational concepts and a review of related literature. The chapter also provides an outline of the study design, methodology, tools and techniques utilised for data generation and analysis. Lastly, the layout of the chapters is specified.

1.2 BACKGROUND

In South Africa, learners are experiencing difficulties with conceptualising common fractions, i.e. learners are not able to relate common fractions to real-life situations (Maphini 2019:3; Quigley, Herro 2019:3; Sierpinska 2019:24). Learners have these difficulties because they are taught in a deductive way, which limits the opportunity for learners to discover things for themselves (Brown & Quinn 2007:24; Conley 2014:439). On the other hand, in Egypt, the work of Loveluck (2012:2) and Kilpatrick, Swafford, and Findell (2001:118) indicates that pedagogical methods and approaches in teaching are also problematic. Learners are encouraged towards memorisation and rote-learning, with the learners being the passive receivers of information which results in a poor understanding of fraction concepts. This is also seen in the United States of America where learners are experiencing difficulties in the adding and subtracting of common fractions with different denominators, e.g. reaching the wrong conclusion that $\frac{1}{2} + \frac{2}{3} = \frac{3}{5}$ (Dhlamini & Kibirige 2014:237; Gabriel *et al.*, 2013:15). Learners do not understand why the lowest common denominators (LCD) are needed when adding and subtracting fractions (Carrillo, Climent, Contreras, & Muñoz-Catalán, 2013:2986;

Gabriel *et al.* 2013:15); hence, there is a need to design a framework for teaching learner's common fractions using the context-based approach.

Maharaj *et al.* (2007:600) and Mdluli (2013:3) confirmed that more practical demonstrations on fractions must be done for learners so that they can improve their conceptual understanding. On the other hand, learners in Nigeria are encouraged to use their existing knowledge and critical thinking to solve problems involving fractions, for themselves with understanding and not through memorising concepts (Rasheed, & Ogundokun 2016:1). Research by Fazio and Siegler (2011:12) and Arcavi (2003:216) argues that in the United States of America (USA), visual representations can be used to help teachers illustrate common denominators when adding and subtracting common fractions, e.g. by using concrete objects to show that $\frac{1}{3} + \frac{1}{2} = \frac{5}{6}$. Brown and Quinn (2007:34) and Simon (2006:370) confirm that the use of partitioning and repeating will assist learners in understanding the meaning of numerators and denominators.

According to Fazio and Siegler (2011:6), Clausen-May (2005:1) and Kolb and Kolb (2005:195), teachers can use different teaching strategies on fractions in their variety of classrooms to create a conducive atmosphere which will help to eliminate poor conceptualisation of fraction concepts. On the other hand, learners in Nigeria are learning in the condition whereby learners are allowed to think for themselves and construct meaning from existing knowledge and real-life situations to solve fraction problems (Brown & Quinn 2007:27; Molefe & Brodie 2010:4). However, in the USA, learners work collaboratively by sharing ideas (Marake 2014:186). The teacher explains if there's clarity needed on how to find the common denominator (Fazio & Siegler 2011:3).

Insufficient time allocated during the teaching of fractions can lead to a poor conceptualisation of the concept due to different learning abilities (Siegler & Forgues 2015:19). This can lead to poor performance for learners who need more time to learn a new concept (Adendorff & Moodley 2014: 424). In the Republic of South Africa (RSA), according to the findings by the Southern and Eastern African Consortium for Monitoring Educational Quality (SACMEQ) III report of 2007, teachers have insufficient content knowledge (CK) because they experienced difficulties in answering question papers of Grade 6 learners on the subject of fractions (Spaull 2013:4). In addition, the work of Chan, Leu and Chen (2007:27) confirms that poor performance concerning fractions, particularly, in adding and subtracting fractions, is due to insufficient pedagogical content knowledge (PCK), which leads to poor performance on

fractions. In overcoming the threats mentioned above, teamwork and workshops need to be in place, and it must be ensured that teachers are placed according to their field of specialisation (Ball, Hill & Bass 2005:21; Carrillo *et al.* 2013:2985).

According to the Department of Basic Education (DBE) (2014:40), it was observed that learners perform well in the addition and subtraction of fractions. The evidence was indicated by an Annual National Assessment (ANA) report from 2012-2014, done on Grades 3, 5 & 6. The average marks obtained for fractions for the various grades were as follows: Grade 3: 41%, 53%, & 56%; Grade 5: 30%, 33% & 37%; Grade 6: 27%, 39% & 43%. These results were obtained by using the approach of context-based strategy in the teaching and learning of fractions. However, in Nigeria, there was a great improvement in learner performance due to the effective teaching methods on fractions. The evidence was indicated by the marks obtained by Grade 4 learners in 2009 and 2012, with the scores on fractions being 25% in 2009 and 39% in 2012 (Sa'ad, Adamu & Sadiq 2014:32). However, in the report published by Trends in International Mathematics and Science Study (TIMSS) (2011:9), Singapore scored 43% using the concrete, pictorial abstract (CPA) approach to the teaching of the subject, far more than other countries, including Japan, Hong Kong and China. Other countries scored up to 30% less in fractions; hence Singapore's results seem to have benefitted because of the concrete, pictorial abstract (CPA).

1.3 PROBLEM STATEMENT

Fractions have been used for centuries and are still being utilised in a great variety of everyday life situations and mathematics. Yet, they are hard for learners to grasp and master (Gabriel *et al.* 2013:1). Learners experience difficulties in understanding the conceptual significance of fractions (Chan *et al.* 2007:28). Loveluck (2012:1) and Spaul, (2013:4) further state that learners are experiencing difficulties in adding and/or subtracting common fractions. According to Ayan and Isiksal-Bostan (2019:2) and Chinnappan (2005:241), learners are unable to relate common fraction concepts to their real-life situations. The work of Rau, Alevan, Rummel and Rohrbach (2013:115) and Shin and Bryant, (2015:380) revealed that this results in learners' context conflicted with common fractions content. This makes it difficult for learners to develop a deeper understanding of common fraction concepts. For these apparent reasons, the researcher found it necessary to conduct her study based on teaching and learning of common fractions for Grade 7 learners, using a context-based approach.

1.3.1 Research question

The main research question is:

How can the teaching and learning of common fractions in Grade 7 using the context-based approach be improved?

In this question, I undertake that the teaching and learning of common fractions need to be improved so that learners can get a deeper understanding of common fraction concepts.

1.3.2 Research aim

This study aimed to design the framework of teaching and learning of common fractions in Grade 7 by using a context-based approach.

1.3.3 The objectives of the study

- How to justify the need to improve effective teaching and learning of common fractions in grade seven Mathematics.
- How to investigate the solutions that could improve the effective teaching and learning of common fractions in grade seven Mathematics.
- How to identify conditions for improving effective teaching and learning of common fractions in grade seven.
- How to identify and circumvent threats that may hinder the effectiveness of teaching and learning of common fractions in grade seven.
- How to suggest evidence that improves effective teaching and learning of common fractions in grade seven.

1.4 BRICOLAGE AS THE THEORETICAL FRAMEWORK OF THE STUDY

Bricolage is used as a theoretical framework underpinning the study in designing the framework to improve the teaching and learning of common fractions in Grade 7, by using a context-based approach. Bricolage originated from a traditional French term, which signifies crafts-people who artificially construct projects from leftover resources (McBratney 2017:6; Rogers 2012:10). Baker and Nelson (2005:335) and Mahlomaholo (2013:3), defined bricolage as a term for a research tactic which creates something out of nothing, by utilising what is accessible to attain new goals and many new conducts as a resolution to real-life problems by using that which has been proven in the situation. Learners can bring waste materials to be used in the class as teaching aids for a better understanding of fractions. Furthermore, bricolage states that researchers are always collaborative and share ways of learning rather than just passively receiving information (Denzin & Lincoln 2005:10). Learners

can work in teams on challenges on fractions to find solutions. Aagard (2009:83) concurs with the above statement that bricolage assists learners to achieve specific objectives as a team, hence bricolage is regarded as multi-perspectival, multi-theoretical and multi-methodological (Rogers 2012:1). Meaning that using, bricolage learners can become critical thinkers, because they can use their different perspectives. Hence, the teacher can be able to use different theories and vary their methods for the learners to get deeper understanding of common fractions concepts. All learners in class are allowed to use different methods to solve fractions by sharing ideas. Therefore, I adopted bricolage for my study, as it permits me to acknowledge people as human beings, not as objects (Mahlomaholo 2013:386).

1.5 OVERVIEW OF LITERATURE

The study aimed to design the framework of teaching and learning of common fractions in Grade 7 using a context-based approach.

1.5.1 Research objectives

1.5.1.1 To justify the need to improve effective teaching and learning of common fractions in Grade 7 Mathematics.

The first objective of the study, as later discussed in detail in Chapter 2, (refer to Section 2.4.1–2.4.4) demonstrates the challenges and justifies the need for a framework to improve the teaching and learning of common fractions in Grade 7 using a context-based approach. Despite the teachers' effort to teach common fractions, learners' challenges in understanding these concepts persist. These challenges are that learners cannot add and subtract common fractions, especially with different denominators. Fazio and Siegler (2011:7) also have a similar view that learners witness numerators and denominators as discrete numbers. In addition, learners have difficulties in ordering common fractions from the minimum to the maximum and vice versa. The learners' difficulty demands that teachers should use a learner-friendly approach in the teaching and learning of common fraction concepts. This approach will involve the contextualisation of teaching and learning of common fraction concepts using concrete objects, such as partitioning and iterating fraction strips for the learners to gain a deeper understanding of common fractions.

1.5.1.2 To investigate the solutions that could improve the effective teaching and learning of common fractions in Grade 7 Mathematics.

This section deals with the second objective of the study (refer to Section 2.4.2.1–2.4.2.4 for more detail) in response to the challenges discussed above.

These solutions are the integration of learners' pre-instructional knowledge with common concept knowledge. This can be done by identifying learners' pre-knowledge and tailor their teaching strategies in a way that would enhance learners' understanding of common fraction concepts. Purwadi, Sudiarta, and Suparta (2019:1114) concur that a concrete-pictorial-abstract approach instils a deeper understanding of common fractions in adding and subtracting common fractions. Hafiziani (2015:115) also shares a similar view allowing learners to use hands-on activities that can assist them in gaining more mathematical, conceptual understanding (MCU) and mathematical representation (MR) on fractions.

1.5.1.3 To identify the conditions for improving effective teaching and learning of common fractions in Grade 7.

This section discusses the circumstances that allowed the employment of a framework as the third objective of the study (see Section 2.4.3.1–2.4.3.4). This objective outlines conditions that are conducive for the teaching and learning of common fractions. The conditions involve identifying learners' conceptions and using them to alleviate learner's problems in common fraction concepts (Jitendra 2020). Moreover, the teacher can assist learners by using concrete objects for the learners to discover rules and procedures for themselves. In addition, the work of Sigler and Fazio (2011:7) suggest that the teacher can conduct the teaching and learning of common fractions whereby learners can observe the numerator and the denominator as a whole number and not as separate numbers.

1.5.1.4 To identify and circumvent threats that may hinder the effectiveness of teaching and learning of common fractions in Grade 7 Mathematics.

This section is about plausible threats to a framework (Refer to Section 2.4.4.1 – 2.4.4.4). A significant threat that might hinder the implementation of the framework is time constraints during the teaching and learning of common fractions, which results in learners memorising rules and procedures (Bailey, Zhou, Zhang, Cui, Fuchs, Jordan, Gersten and Siegler 2015:70; Thurtell 2019:39). DBE (2014:175) states that the teaching of common fractions needs more time due to their complexity. Furthermore, the work of Ndalichako (2013:169) shares the same view that teachers need to give common fractions more time to penetrate the complexity of common fraction concepts. Therefore, more time is required to limit learners memorising common fraction concepts (Ndalichako 2013:170; Thurtell 2019:39). On the other hand, the work of Kolb (2007:9); revealed that different types of learning styles could be used to accommodate the different types of learners that are in the classroom during the teaching and learning of common fractions.

1.5.1.5 *To suggest evidence that improves effective teaching and learning of common fractions in Grade 7.*

The fifth objective of the study is cross-examined in Sections 2.4.5.1 - 2.4.5.4 providing evidence of potentially the best practice towards the teaching and learning of common fractions in Grade 7 using a context-based approach. Many authors share a similar view that, for common fractions to be understandable to the learners', pre-conceptions must be well traced by teachers (Durkin & Rittle-Johnson 2015:22; Smith, Disessa & Rochelle 1994:122; Tariq 2008:890). Tirosh, (2006:6) also confirmed that PCK plays a major role in teachers being able to identify learners' misconceptions during the teaching and learning of common fractions. Furthermore, Pashler, McDaniel, Rohrer and Bjork (2008:110) postulated that different types of models could also assist learners in understanding common fraction concepts.

1.6 RESEARCH DESIGN AND METHODOLOGY

Participative Action Research (PAR) was chosen as the research methodology to improve the teaching and learning of common fractions in Grade 7 using the context-based approach. This decision was powerfully influenced by the work of Freire, who utilised PAR to inspire unfortunate and disadvantaged communities to examine and analyse the mechanical explanations for their oppressions (Baum, MacDougall and Smith 2006:854). Utilising PAR assisted the process in which co-researchers worked cooperatively to combine knowledge and action for community change (Delman 2012:231). This practice assisted learners to work together to solve common fractions. According to Bodorkós and Pataki (2009:320), PAR aims to achieve empowerment for those who are involved. Therefore, learners and teachers could gain knowledge about the teaching and learning of common fractions. PAR promotes democracy, respect, hope and social justice. PAR enables teachers and practitioners' inquiry to become more collaborative and democratic in the ways of meaningfully engaging learners and other educators in the full range of action research from problems identified (Bodorkós, and Pataki 2009:313; Sleeter 2008:140).

1.7 DATA GENERATION

Data was generated through class discussions and lesson observations.

During our gatherings, audio and videotapes were utilised for data capturing. The team depicted an action strategy, with activities that were utilised in generating data. For reasons of retaining confidentiality and anonymity, the school and co-researchers used pseudonyms

instead of using real names. Class discussions were held to allow everyone to talk, i.e. for learners' voices to be heard.

1.8 DATA ANALYSIS

The researcher selected Van Dijk's Critical Discourse Analysis (CDA) in analysing and interpreting data to gain a deeper understanding of fractions (refer to Section 4.1). CDA is a multi-disciplinary approach concerning the discourse position of power (Kiersey and Hayes 2010:332). The research team chose the CDA because it allowed various ways of arriving at the truth. CDA has hidden meaning that helps to analyse data on three levels: contextual, social and text. On a textual level, the aim is to develop a deeper understanding of what understanding learners and teachers have regarding common fractions, to understand clearly why learners are struggling not to make mistakes. On the other hand, the work of Rogers (2012:1) further describes a critical, multi-perspective approach to research, because the co-researchers are allowed to share their ideas. Therefore, all learners involved will positively engage in researching the teaching of fractions.

1.9 THE VALUE OF THE RESEARCH

The study contributes towards the Department of Education's endeavours in cascading information with other schools and improving the effectiveness of teaching common fractions to Grade 7 learners. Subsequently, it will assist in improving learner performance so that they can use common fractions as a vehicle to solve problems in their real-life situations. As an alternative, it emphasises encouraging and empowering teachers to solve problems that they have in their classes concerning the teaching of fractions.

1.10 ETHICAL CONSIDERATION

The study sought full permission from the University of Free State and the KZN Department of Basic Education (DBE). All co-researchers who participated in the research agreed to participate by signing consent forms voluntarily. The forms were translated into isiZulu to be user-friendly to the associates. The forms clearly stated that people are not forced to participate. They were guaranteed of concealment concerning the information they contributed and were informed that they could withdraw at any phase of the study without having to give any reasons.

1.11 LAYOUT OF CHAPTERS

Chapter 1: Layout of the study

This chapter outlined an introduction to the study, the research aim and objectives, data generation, research design and methodology, critical discourse analysis, ethical consideration and value of the study.

Chapter 2: Theoretical Framework and Literature Review

The chapter begins by discussing the theoretical framework, origin and objective of the framework focusing on how they influenced the teaching of fractions around the world. The chapter also discusses the need to design a framework describing how important it was to have the collaboration from stakeholders in this regard. I then provide evidence of this collaboration by going through empirical work related to my study.

Later, I review the literature outline and discuss the specific challenges that yielded the need to design the framework. Further, the chapter discusses the conditions conducive for the research based on the reaction of the stakeholders and envisaged threats that may impede the study.

Chapter 3: Research design and methodology

This chapter starts with the presentation of methods and processes that were used in generating data from the co-researchers to design a framework to improve implementation of teaching and learning of common fractions in Grade 7 using a context-based approach. Then, the chapter further deliberates the speeches and the plan of action that was drawn up by the chosen coordinating team to classify the need and components of the framework and regulating the settings that are conducive for the construction of a framework. This chapter also integrates the theoretical stance and constructs developed in the chapter.

Chapter 4: Data analysis

This chapter deals with the information investigation, as well as the demonstration and interpretation of the outcomes, for designing a framework to improve the implementation of the teaching and learning of common fractions in Grade 7 using a context-based approach. The critical discourse analysis methodology was used to assist in exploring texts directing

the activity to uncover significance rooted in the language, while also seeing what the nuances of the school under research were and how these influenced the status quo.

Chapter 5: Findings and recommendations

The findings and recommendations outlined in the chapter reflect the perceptions of co-researchers. Their views are respected in the interpretation of the findings used to design the framework for the teaching and learning of common fractions in Grade 7 by using a context-based approach.

1.12 SUMMARY OF THE CHAPTER

The chapter begins with the introduction and the background of the study. The problem statement to be solved and the research question, aim and objectives of the study were introduced. The research design and methodology used were clarified. The study finds significance assurance in the principles of the theoretical framework (bricolage) underpinning the study. The value of the research and the ethical considerations were deliberated.

2 CHAPTER TWO: THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 INTRODUCTION

The study aimed at designing a framework for the teaching and learning of common fractions in Grade 7 using a context-based approach. The study is underpinned by bricolage as an appropriate theoretical framework in pursuing the objectives of the study. This chapter discusses the literature, starting by discussing the origin of bricolage using eight historical moments. Different types of bricoleurs, formats and objectives of bricolage are also discussed. This chapter further discusses the role of the researcher, the relationship between the researcher and the co-researchers, epistemology and ontology is defined and discussed by the operational concepts, which anchor the study. Lastly, the review of literature is related to five objectives. These objectives are challenges, solutions, conditions, threats and indicators of success in the teaching and learning of common fractions in Grade 7. The literature review is done for South Africa, the Southern African Development Countries (SADC), the African continent and internationally.

2.2 BRICOLAGE AS THEORETICAL FRAMEWORK OF THE STUDY

Bricolage is a critical, multi-perspectival, multi-theoretical and multi-methodological approach) (Filimowicz 2018:271; Rogers 2012; Rose & Björling 2017:4; Whitsed, & Wright 2016:594 &). In a broader sense, this means the teacher should allow learners to take an active part in the teaching and learning of common fractions. Participating actively allows learners to give their perspectives about these concepts, which allows the teacher to discover pre-instructional concepts that learners have in common on fraction concepts. Moreover as Champagne Queloz, Klymkowsky, Stern, Hafen, and Köhler, (2017:1); Ndiokubwayo, Uwamahoro, Ndayambaje and Ralph (2020:2) indicated that this allows the teacher to select different teaching methods and theories that can address learners' misconceptions in these concepts.

For instance, the teacher can use fraction strips to demonstrate that $\frac{1}{3} = \frac{2}{6} = \frac{3}{9}$, for the learners to get a deep conceptual understanding of equivalent fractions. According to Given (2008:66) and Lincoln (2001:693) a bricoleur is a kind of a person who uses different approaches to find solutions to a common problem. For this study, this notion implies that the teacher can penetrate the complexity of common fractions and enhance the understanding

of common fractions during the teaching and learning process. This could be achieved by understanding learners' learning styles so that the teacher can tailor the teaching instructions that accommodate the learners' diversity (Mahlomaholo 2013:292; Naghavi 2015:8; Putnam & Borko 2000:4). On the other hand, the work of Chin, Blair, Wolf, Conlin, Cutumisu, Pfaffman and Schwartz (2019:337) and Pritchard (2017:34) posit that learners can use available resources in class to construct critical thinking and develop independency in learners when they solve their problems during teaching and learning of common fractions. As Aagard (2009:84) and Baker and Nelson (2005:329) suggested about using material at our disposal to solve the problem at hand, the teacher as a bricoleur can use resources like visual representations, concrete demonstrations, and pictorial representations to solve addition, subtractions, multiplication and division of common fractions. For example ($\frac{1}{2} + \frac{1}{3}$; $\frac{1}{2} - \frac{1}{3}$; $\frac{1}{2} \times \frac{1}{3}$; $\frac{1}{2} \div \frac{1}{3}$). In line with Aagard's (2009:84) study, I think it is necessary for me to develop a context-based strategy for the teaching and learning of common fractions in Grade 7 using bricolage as a theoretical lens. Discussion of the origin of bricolage can be understood better when it is done through eight moments of qualitative research (Denzin & Lincoln 1994:3). These eight moments of bricolage are as follows: the traditional period, the modernist phase, blurred genres, the crisis of representation, the post modern period, the post-experimental inquiry, the present time and fractured futures. The following paragraphs will provide a brief description of the moments mentioned above.

2.2.1 The historical origin of bricolage

The word bricolage comes from the French word bricoleur, which implies a process of creating something new out of the resources available to address the problems in a real-life situation (Baker & Nelson 2005:329; Kincheloe 2004:1; Rogers 2012:1). In an attempt to instil creativity, the teacher gave learners the following problem that involves a real life situation. Learners were given a 3-metre wire to construct either object A or object B. To construct object A; learners had to use $\frac{1}{2}$ a meter for each object A and use $1\frac{1}{2}$ meter for each object B. How many object A items can be made from a 3-meter wire? In addition, how many object B items can be made from a -3 meter wire?

In response to the question above, learners constructed forks for object A and another learner constructed sunglasses for object B, as shown in Fig 2.1 below. This approach promotes creativity and innovation in learners where A needs $\frac{1}{2}$ a meter of wire and B needs $1\frac{1}{2}$ meters

teaching and learning of common fraction concepts using concrete objects. This assisted learners to link their prior knowledge to common fraction concepts knowledge. In support of this, Kincheloe (2005:337) avers that bricolage emphasises the importance of learners prior knowledge in enhancing learner's understanding of common fraction concepts. In the example above, learners divide $3 \div \frac{1}{2}$ with ease by only using prior knowledge and get an answer equal to six (Molebale 2005:54). In addition, the learners succeeded to divide $3 \div 1\frac{1}{2}$, they further managed to get two, which is the correct answer, without using rules and procedures (Maharaj *et al.* 2007:600; Molebale 2005:54).

2.2.1.1 First moment: The traditional period (1900-1950s)

The first moment of qualitative research was developed by Denzin and Lincoln and called the traditional period (Baker 2003:260; Baloyi 2018:15; Mahlomaholo 2014:174). According to Flick (2013:6) and Baker (2003:155), the traditional period began at about 1900 and ended in 1950. This moment emphasises the knowledge of rules and procedures that are involved in the teaching and learning of common fractions (Baloyi-Mothibeli 2018:15; Lewis 2009:1; Given 2008:312). This assisted the learners in developing procedural fluency in common fraction concepts, which resulted in learners developing an understanding of these concepts (Kincheloe 2005:326; Lee, Brown, and Orrill 2011:198). This procedural fluency in common fractions helped learners to solve problems that are related to this concept. For instance, if rules used during the teaching and learning of common fractions are used in such a way that learners gain a deeper conceptual understanding of common fractions and can discover those particular rules by themselves, then they were regarded as good (Suh, Moyer & Heo, 2005:2). For instance, given a problem like $\frac{3}{5} + \frac{1}{5}$ then, the following rule had to be followed: If we add fractions with the same denominators, you consider the common denominator, and then you add numerators e.g. $\frac{3}{5} + \frac{1}{5} = \frac{4}{5}$ (Pantziara & Philippou 2012:66; Lortie-Forgues, Tian & Siegler 2015:11; Suh, Moyer & Heo 2005:2). The DBE (2011:8) also supports that the learner should learn to listen, communicate, think, reason logically and apply the mathematical knowledge gained.

While this approach could be useful in the teaching and learning of common fraction concepts, it comes with some limitations. These limitations involve the memorisation of rules and procedures that are required to solve common fraction concepts. This practice promotes a monological approach to the teaching and learning of common fractions where the teacher

was the sole source of information (Kincheloe 2005:326; Lee *et al.* 2011:198). According to Shivda (2017:58) and Tambara (2015:27) during this period, the focus was on memorisation and mastering of laws, rules and procedures about the teaching and learning of common fractions. This compromises a conceptual understanding of common fractions. As a result, learners fail to transfer their knowledge into new situations and apply it in a new context (Stigler & Hiebert 2009:50). This monological approach does not accommodate different types of learners in the class, and it promotes reductionist thinking in learners (Davis & Franklin 2004:53; Erduran 2007:249; Felder 1996:19; Naghavi 2015:10). As the results show, it compromises the conceptual understanding and limits learners from discovering rules themselves. This led us to the Second moment, namely the modernist phase.

2.2.1.2 *Second moment: The modernist phase (1950-1970s)*

The second moment is known as the modernist phase of qualitative research (Locke 2003:4). This moment started in 1950 and ended around 1970 (Onwuegbuzie, Leech and Collins 2010:697; Denzin & Lincoln 2012:313). The Modernist phase falls under mixed methodologies or quasi methodologies because it is composed of both a qualitative and a quantitative methodology, and is known as a mixed-method (Wagner 2012:32). During this moment, the teacher accommodates different types of learners that are in the class. In doing so, the teacher is embracing multiplicity concerning the teaching and learning of common fractions. For instance, the following problem was given to the learners: How many halves can you get from 2? Learners were divided into three groups; the first group used two pieces of paper and folded it into two halves. They then counted the number of pieces and got the answer of four.

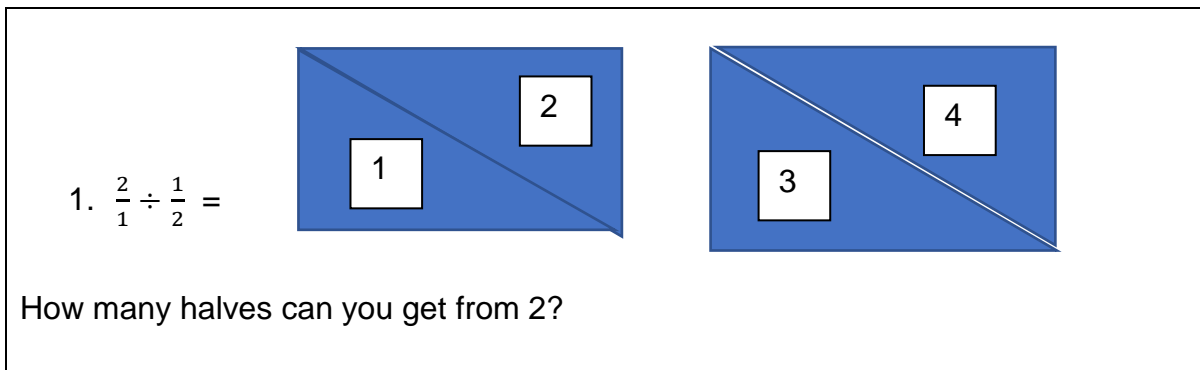


Figure 2.2: Representing the piece of A4 paper

Furthermore, the second group also used fraction walls, refer to Fig 2.3, to make the division, and arrived at an answer, which was four.

1		2		
1	2	3	4	

Figure 2.3: Demonstrating fraction walls.

On the other hand, the third group used theoretical rules and procedures without doing it practically, and they obtained four as the answer. $\frac{2}{1} \div \frac{1}{2} = \frac{2}{1} \times \frac{2}{1} = 4$. Learners were able to discover the rules and procedure for themselves (Lestiana, Abadi, Abels, & van Eerde 2014:13). This moment of bricolage, which is the modernist phase, allows me to address some limitations that were identified above. These limitations were a teacher-centred and monological approach.

According to Lestiana *et al.* (2014:8), this moment supports a learner-centred approach, as learners will be actively involved in dealing with fractions and share their experiences. This awards the teacher and the learner an opportunity to learn from each other by sharing knowledge and contributing their ideas during the teaching and learning of fractions (Mdluli 2013:19; Ni & Zhou 2005:40). Furthermore, it places the learner at the centre of the teaching and learning process. By so doing, the learner gets an opportunity to penetrate the complexity of common fraction concepts (Kincheloe 2005:324).

In as much as this moment had an excellent contribution in the teaching and learning of common fraction concepts, such as accommodating all types of learners in a class and a learner-centred approach, it still had some limitations in problem-solving strategies. The modernist phase moment paved the way for the third moment, which was the blurred genres moment.

2.2.1.3 Third moment: Blurred genres (1970s-1986)

The third moment of qualitative research, known as blurred genres, started from 1970 and ended in 1986 (Baloyi- Mothibeli 2018:17; Denzin & Lincoln 2008:23). During this period, the approach to qualitative research was advanced, and different researchers came up with different methods and strategies that diversified the research approach (Birks & Mills 2014:7). For instance, the teacher asks the learner to represent the following sum in a fraction, ratio and per cent form. An apple must be divided amongst two learners. For instance, fractions can be expressed in multiple ways such fractional form as, $\frac{1}{2}$, in ratio format 1:2, and 50% as the percentage form (Dole 1999:55). The teacher was successful in demonstrating the different solving strategies to the learners, which addressed the limitations of the modernist phase but confused learners because of the many different strategies involved.

In similar vein, there were limitations that hindered learners from developing a deep understanding of common fractions. These could include an inability to perform arithmetic manipulation on whole numbers, decimal fractions, and common fractions due to a limiting construction (Brown & Quinn 2007:8). According to Brown and Quinn, (2007:8) and Newstead and Murray (1998:6), a limiting construction is when the teacher who teaches common fractions, teaches in such a way that learners are unable to see common fractions as a number, but see common fractions as two separated whole numbers. For instance the $\frac{1}{2} + \frac{2}{3} = \frac{3}{5}$ explanation to learners limits learners' thinking about the common fraction concept. This limitation made it necessary to proceed to the next moment, which was the "crisis of representation".

2.2.1.4 Fourth moment: Crisis of representation (1986-1990)

The fourth moment of qualitative research, also known as the crisis of representation, started from 1986-1990 (Lewis 2009:6; Mills & Birks 2014:7; Onwuegbuzie *et al.* Collins 2010:698). During this moment, there was an abundance of theories and methods that was used to approach research projects (Given 2008:315). The abundance of theories means the teacher

could use multiple theories and methods to teach common fraction concepts to accommodate the learners' diversity. During this moment, researchers had the crisis of representing different research theories (Mills & Birks 2014:7).

The common fractions crisis of representations is reflected when teachers and learners have a challenge in the representation of common fractions. This was prominent when the learners pronounced fractions like $\frac{1}{3}$ as one over three instead of one third and $\frac{2}{3}$ as two over three instead of two-thirds (Booker 1998:132; Jordan, Rodrigues, Hansen and Resnick 2017:136). This crisis emanates from the whole number concept approach that the teacher used when teaching common fraction concepts (Brown & Quinn 2007:8; Desta 2019:32; Siegler, Thompson, & Schneider 2011:273). The teacher then pronounces the fraction as two separate numbers. For example, the teacher pronounces $\frac{3}{4}$ as three over four. The common mistake that learners commit due to the whole number concept approach is reflected when they are adding or subtracting common fractions. For example, $\frac{1}{3} + \frac{3}{5} = \frac{4}{8}$, this means they just add numerators and denominators together (Bruce & Ross 2009:12; Mdluli 2013:22). From this example, one can deduce that, because of the teacher's whole number concept approach, learners add the fractions in the same way as they add the whole numbers. This indicates the lack of common fraction sense from the side of teachers. Desta (2019:101) define common fraction sense as fundamental perceptions and conceptions that the teacher possesses in common fraction concepts. Common fraction sense can assist the teachers in developing the appropriate teaching strategies that can assist learners in developing an understanding of common fraction concepts. According to Kincheloe (2012:4) and O'Regan (2015:335), this helped to build the conceptual understanding of common fraction concepts.

Although this moment could assist in accommodating different learners using multiple theories and methods, it had some limitations. For example, if different teaching methods to teach common fractions are not properly used, they can confuse the learners. Therefore, it was necessary to move to the fifth moment, the postmodern period to create a suitable model for the research.

2.2.1.5 *The fifth moment: The postmodern period (1990 -1995)*

The fifth moment of qualitative research or the postmodern period started in 1990 and lasted up until 1995. This was known as a period of experimental and new ethnographies (Atkinson, Coffey & Delamont 1999:460). According to Denzin and Lincoln (1998:22, 2005:20) and

Lewin (2009:2); the emphasis in this period was on local knowledge. Furthermore, researchers had the notion that knowledge was socially constructed (Lincoln, Lynham, & Guba 2011:16). The researchers came closer to the co-researchers to understand their stories (Mahlomaholo (2014:175). This shows the significance for the teacher to get close to the learners to understand the learner's context and culture. This helps the teacher to integrate learners' content and the context to make sense of common fraction concepts. This period also promoted co-operative and collaborative work amongst learners, which was the good thing about this moment. This assisted the learners in working together and taking on an active role in the process of knowledge co-construction.

In addition, Baker and Nelson (2005:300) posit that knowledge embraces multiple interpretations of texts and diversity. From this perspective, one can suggest that the teacher as a bricoleur, should use multiple methods when teaching common fraction concepts. This is demonstrated when the teacher gives the learners the following sum to work on in groups: If $\frac{1}{2}$ a bowl of mealie-meal is needed to make porridge for five people (Lortie-Forgues *et al.* 2015:11), how much mealie-meal is needed for ten people? Further, calculate the percentage, common fraction and decimal fraction for that number of people. There are limitations about this moment, group work is time-consuming, and it is difficult to work with bigger classes. Heller, Keith, and Anderson (1992:627) and Cohen and Lotan (2014:1) confirm that It is difficult to implement group work teaching when dealing with bigger classes. Therefore, it was necessary to explore the sixth moment.

2.2.1.6 Sixth moment: The post-experimental (1995 -2000)

The sixth moment of qualitative research, which occurred around 1995 to 2000 (Flick 2018:19; Lewin 2009:2; Onwuegbuzie *et al.* 2010:698). During the sixth moment, researchers believed that the construction of knowledge must embrace a multiple-approach method (Mahlomaholo 2014:176). Similarly, in common fractions, this approach could allow for the use of different methods of teaching common fraction concepts. This can assist the teacher in accommodating learners' diversity (Kinchloe 2005:328; Naghavi 2015:10). Since learners are from different backgrounds and cultural context, they have different ways in which they select and make sense of common fraction concepts. The teacher can achieve this by varying the teaching and learning methods (Fuchs, Fuchs, Mathes, & Simmons 1997:174; Pashler *et al.* 2008:105). The teacher gives visual learners fraction strips and shows them how to fold three identical strips. He started by half and shades $\frac{1}{2}$, followed by the second strip and told

learners to fold twice and shade $\frac{2}{4}$. Lastly, learners fold the third strip two more times and shade $\frac{4}{8}$. Learners discover for themselves that $\frac{1}{2}$, $\frac{2}{4}$ and $\frac{4}{8}$ are equivalent fractions (Suh *et al.* 2005:4). This could benefit visual learners since visual learners learn better by seeing things (Mdluli 2013:15).

On the other hand, auditory learners benefit better from using rules and procedures to learn equivalent fractions. For instance, given $\frac{1}{2} \times 1$, where (1) is the same as any number over itself, hence we can still write 1 as $\frac{2}{2}$ and $\frac{4}{4}$, then we can multiply any fraction as follows $\frac{1}{2} \times \frac{2}{2} = \frac{2}{4}$; $\frac{1}{2} \times \frac{4}{4} = \frac{4}{8}$. Therefore $\frac{1}{2} = \frac{2}{4} = \frac{4}{8}$. Auditory learners can understand better if rules and procedures involved in solving this problem are explained clearly.

Therefore, an approach from this moment mitigates the risk factors identified above, because it uses different methods to teach common fraction concepts. However, this approach came with some limitations. Some of these limitations are challenges are that teachers find it difficult to use a multiple approaches to the teaching and learning of common fractions, and it is time-consuming. This paved the way to move towards the next moment.

2.2.1.7 Seventh moment: The present time (2000 -2010)

The “present time” represents the seventh moment of qualitative research, which commenced in 2000 up until 2010 (Given 2008:311). During this moment, researchers emphasised the recognition of values (Denzin 2001:326). I will use “sharing” because learners like sharing. The teacher should, therefore, combine learner’s values and content knowledge of common fractions, so that learners can be able to conceptualise common fractions (Tchoshanov 2010:142;). This can be done by giving learners some activities where they will share birthday cake amongst themselves (Tobias 2005:126). Since learners value equal sharing, they will make sure that the birthday cake is equally shared. By doing this, the teacher will be contextualising the teaching and learning of common fraction concepts by linking the learners’ content and context. For instance, a birthday cake is shared equally amongst four girls, express the portion that each girl will receive in fraction form, ratio, and percentage, e.g. one cake, divided by four = $\frac{1}{4}$ as a fraction, 1:4 as a ratio, and $\frac{1}{4} \times \frac{100}{1} = 25\%$ as a percentage.

Furthermore, using learner’s ethics and morals, promoting a context-based approach during the teaching and learning of fractions can make fractions meaningful to learners (Fuchs,

Schumacher, Long, Namkung, Hamlets, Cirino, Jordan, Siegler, Gersten, & Changas 2013:8). The good thing about this moment is that of equal sharing. Although learners do not value the same things, because of cultural conflict, which is a limitation. Hence, it paved the way towards the eighth moment the fractured future.

2.2.1.8 Eighth moment: The fractured future (2010 - date)

The eighth moment of qualitative research, “fractured futures”, occurred approximately from 2010 (Denzin & Lincoln 2005:5; Mahlomaholo 2014:175; Higgs, & Cherry 2009:7). This period is about a multiplicity of perspectives and the teacher involving learners. Mahlomaholo (2014:175) and Moschkovich (2012:17), refer to the many diverse ways in which teachers and learners generate knowledge during the teaching and learning of common fractions. In this case, one might say in these days, teaching and learning should be learner-centred, where learners can come up with different approaches to arrive in one solution. Furthermore, different methods can be used to make learners understand fractions to gain a deep conceptual understanding of common fractions (Tirosh 2000:8). For example, Zinhle decided to take an offer of a 50% discount on flowers selling for R100-00. However, she is not sure how much she should pay for the new selling price. What is the fraction of the selling price?

Therefore $\frac{50}{100} \times \frac{100}{1} = R50-00$, Meaning that $R100- R50-00 = R50-00$ new selling price.

Then, the fractional form of the selling price can be expressed as follows $\frac{50}{100} = \frac{1}{2}$. By doing this, the teacher uses rules and procedures.

On the other hand, some learners use mental calculations and come up with an answer. The price before the discount was given as R100-00, while 50% is the discount of 100 = R50-00 the teacher accommodates different types of learners that are in the class (Nkoane 2006:35; Baloyi- Mothibeli 2018:10). Mental calculation means learners engaged themselves mentally in calculations of the sum without writing the steps and came up with an answer (Brown, & Quinn 2006:8, 2007, 28). The teacher uses the context around learners. Therefore, by accommodating different types of learners in the class. The eighth moment can be concluded as a good thing. Like other moments, this moment has some limitations. Since this moment uses different contexts to help learners to understand common fraction concepts, it became difficult for the teacher to accommodate the different learners’ contexts.

2.2.2 Formats of bricolage

The following section discusses the formats of bricolage. This is done by examining different types of bricoleurs and how each is relevant in the development of the strategy that will enhance teaching and learning of common fractions in the Grade 7 mathematics class. These different types of formats are as follows: interpretive bricoleur, methodological bricoleur, theoretical bricoleur, political bricoleur, and narrative bricoleur (Rogers 2012:4). The discussion of formats is done to enhance the understanding of common fraction concepts. This means that common fractions can be more meaningful to the learners if the teacher can use different types of methods. By doing so, the teaching of common fractions will be learner-centred, and learners can discover rules that are involved in common fractions by themselves. The following paragraphs will provide a brief description of the above-mentioned formats.

2.2.2.1 Interpretive bricoleur

According to Kincheloe, (2005, 335, 2012:12), Rogers (2012:4) and O'Regan (2015:459); interpretive bricoleurs have different interpretive approaches that came from hermeneutics. These bricoleurs embrace the belief that there is no one correct telling of an event. This means that learners have different perspectives about common fractions that are based on their contexts and experiences. Therefore, it is essential that the teacher should use a different approach that will cater to different learners during teaching and learning of common fractions. This can assist teachers in detecting the challenges that will emerge during the teaching and learning of common fraction concepts using the context-based approach. For example, during teaching and learning, learners could be asked the following question: Given 2 watermelons of the same size. You cut one of them into four equal-sized pieces and another one into eight equal-sized pieces. If you are offered to choose one bigger piece between two watermelons, which one will you choose? Then learners will be able to see and compare these pieces. They will be able to see the bigger piece. This assists them to discover that $\frac{1}{4}$ is bigger than $\frac{1}{8}$ (Mack 1990:22).

2.2.2.2 Methodological bricolage

According to O'Regan (2015:461) and Rogers (2012: 5), bricoleurs use different methods to penetrate the complexity of reality. Phillimore, Humphries, Klaas and Knecht (2016:12) argue that using multiple methods to accomplish the task allows the researcher to relate and compare a different tool at hand that is used to accomplish the goal. For the same reason, I

found it necessary to use different approaches during teaching and learning of common fraction concepts to enhance the understanding of common fraction concepts in learners. Different methods can assist me in accommodating diverse learners, since different learners learn differently (Felder 1996:19; Naghavi 2015:10). This assists me to overcome challenges that emerge during the teaching and learning of common fractions and turn them into opportunities. This was done by using learners' misconception and develop them towards understandable fraction concepts (Naghavi 2015:10; Othman, & Amiruddin 2010:653).

2.2.2.3 Theoretical bricolage

Rogers (2012:4) posits that theoretical bricoleurs use multiple-theoretical paradigms to acquire knowledge. According to Rogers (2012:4) theoretical bricoleurs must have a knowledge of several interpretive paradigms that can be used to understand and solve different problems. This demands that teachers should have deep pedagogical content knowledge in mathematics education (Gbadegeshin 2018:104). To be critical, multi-perspectival, multi-theoretical and multi-methodological in their approach during teaching and learning of common fraction concepts (Rogers 2012:6; Depaepe, Torbeyns, Vermeersch, Janssen, Kelchtermans, Verschaffel & Van Dooren 2015:82). The following problem was given as an example. Compare $\frac{1}{3}$ and $\frac{1}{6}$ (McNamara & Shaughnessy 2010:18). Then the teacher can use more of the same size parts as follows.

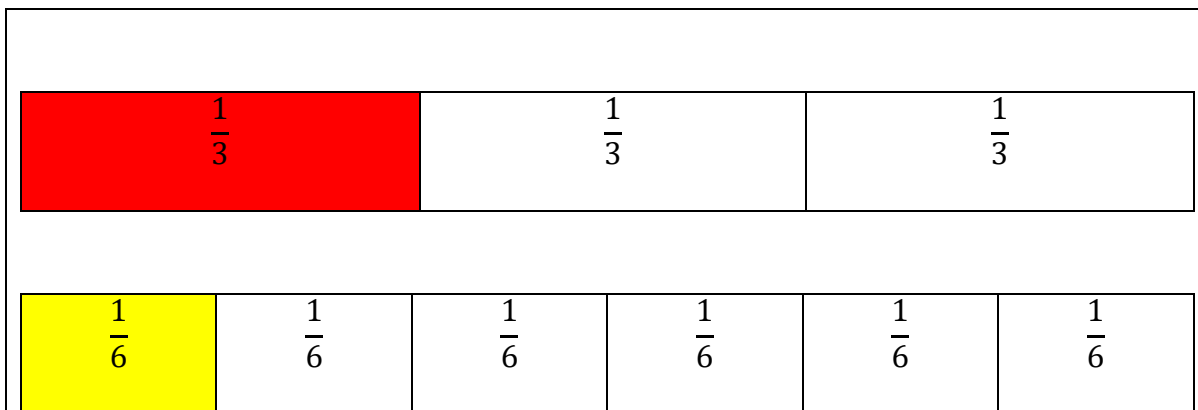


Figure 2.4: Comparing fractions

$$\frac{1}{3} \text{ and } \frac{1}{6}$$

Fig. 2.4 demonstrates that thirds are larger than sixths, so $\frac{1}{3} > \frac{1}{6}$. After that, the teacher can also find the correct answer by using rules and procedures that are involved in common fractions (Mdluli 2013:53; Tirosh 2000:15), by finding the common denominator of $\frac{1}{3}$ and $\frac{1}{6}$. Secondly, the teacher uses another method of rules and procedures to find the bigger fraction between $\frac{1}{3}$ and $\frac{1}{6}$, as follows. The teacher starts by finding the LCM of 3 and 6, using multiples of 3 and multiples of 6.

The first set is multiples of 3: 3, 6, 9, 12, and 15

The second set is multiples of 6: 6, 12, 18, 24, and 30.

Then learners can select the lowest common multiple from both sets, which is the smallest number that can be found from both sets, which is 6. After that, the teachers asks how many times 3 goes into 6; find 2 times and then multiply by 1, then the product is 2. Lastly, 6 goes into 6 one time, and then 1 is multiplied by 1, and the product is 1. Thus end up with the sum below, meaning that because these fractions share the same denominator, then the bigger fraction would be determined by the bigger numerator. Therefore $\frac{1}{3}$ is greater than $\frac{1}{6}$ (Murray, Olivier, De Beer 1999:4)

Then 6 is the lowest common multiple of 3 and 6; you can refer to the above-mentioned multiples of 3 and 6. From the above figure that is accompanied by the description, it can be concluded that $\frac{1}{3}$ is greater than $\frac{1}{6}$, because these fractions share the same denominator and

2 is bigger than 1. If two fractions have a similar denominator, it becomes easy for the learners to compare and find out that the fraction with the bigger numerator is bigger. The use of the diagram and procedures assist the learners to understand that $\frac{1}{3}$ is greater than $\frac{1}{6}$. From this, the learner can conclude that the fraction with the small denominator is greater provided the numerator is 1.

2.2.2.4 Political bricolage

Political bricolage is trying to address the issue of power during the process of knowledge creation (Domenico & Haugh 2010:681; Kincheloe 2005:329; Rogers 2012:6). According to Kincheloe (2005:343); and Rogers (2012:6), political bricoleurs argue that the knowledge production process should involve those who are marginalised and should benefit those that are disadvantaged. This means teachers should refrain from displaying their power by being the sole source of information and take learners as empty vessels to be fed with information, instead let the learners take an active part in the co-construction of knowledge about common fraction concepts. Hiebert, Morris, Berk, and Jansen, (2007:48), Ball and Forzani (2009:497), asserted that this allows that the teacher to make sure that the process of teaching and learning of common fraction concepts benefit the learners. Given this scenario, $5 \div \frac{1}{2} = \frac{5}{1} \times \frac{2}{1}$ this is whereby learners ask the teacher, "Why do you change the division sign to a multiplication sign? (Tirosh 2000:20).

Furthermore, Morake (2014:15) posit that during dialogue, teachers or learners may explain and ask questions. This concurs with PAR, which stipulates that the learners, as the people with the problem about common fractions, should be given a chance to take an active role in finding solution into their problem. This empowers and emancipates learners as stipulated in PAR principles (Baloyi- Mothibeli 2018:73; Fraser, Murray, Hayward, and Erwin 2004:26). This could be done by using the learners' context in such a way that the learners discover the rules for themselves. For instance, the following example refers to Figure. 2.5, showing how the teacher could use the virtual manipulative to add common fractions. For example, two learners are taking pieces from a pizza box that was divided into eight pieces. Thabo took 1 piece out of 8 pieces and Zanele took 2 pieces out of 8 pieces. Calculate the total number of pieces taken from the pizza box. Therefore, the denominator does not change, because the number of pieces in the box of pizza does not change.

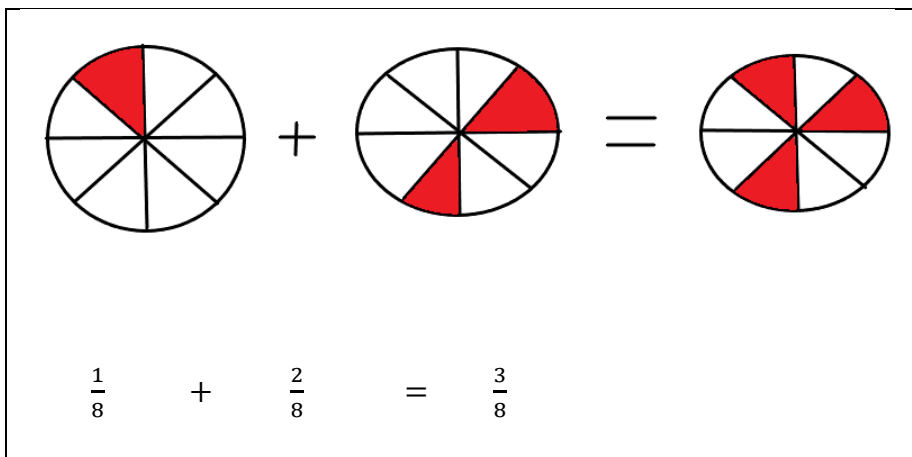


Figure 2.5: Virtual manipulation

$\frac{1}{4} + \frac{1}{8} = \frac{2}{8} + \frac{1}{8} = \frac{3}{8}$ (Suh *et al.* 2005:55). Furthermore, it can be noted that $\frac{1}{4} = \frac{2}{8}$, they are equivalent fractions. From the context, you can teach equivalent fractions better by using the following diagrams

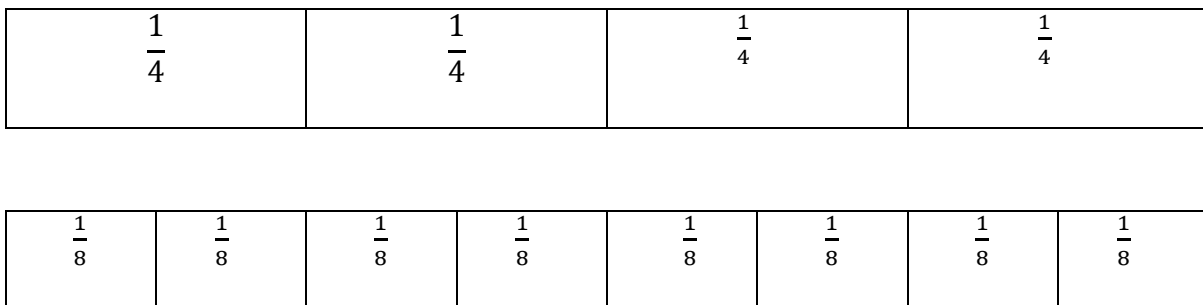


Figure 2.6: Diagrams for equivalent fractions

In addition from the above one can notice that $\frac{1}{4}$ resulted in $\frac{2}{8}$, because $\frac{2}{8}$ is made of two $\frac{1}{8}$.

2.2.2.5 Narrative bricolage

According to Kincheloe (2005:336); narrative bricoleurs believe that enquiry is representational. Rogers (2012:7) adds that peoples' contextual perspectives play an important role in text creation. This means that during teaching and learning of common fraction concepts, it is important that the teacher should use learners' context to enhance their understanding of these concepts. Using learners' context brings learners experiences onboard, which make it easy for learners to link their pre-knowledge to new common fraction concepts knowledge (Kim, Ke, & Peak 2017: 620).

Furthermore, when the teacher uses stories that emerge from learners' historical backgrounds to teach common fractions, this helps to contextualise teaching and learning of these concepts. For instance: Bongwiwe had two different types of illness when she was five years old. After consulting the doctor, she had to take her medication twice a day as follows: $\frac{1}{4}$ of a teaspoon in the morning and $\frac{1}{2}$ of a teaspoon at night. How much medication did she take altogether (Cramer & Wyberg 2009:233)?

2.2.3 Ontological perspective of bricolage

According to Kincheloe (2004:29), the ontological stance of bricolage assumes the notion that truth is not fixed and it is impermanent. This means that the ontology of bricolage is that truth is complex, and it is ever-changing. By implication, this could mean, the truth is not fixed but subjective (Kincheloe, McLaren & Steinberg 2011:170). Therefore, the teacher must know and understand the learner's ontologies because it serves as the learner's context. That is how learners view the world around them. This assists the teacher in contextualising teaching and learning of fractions to accommodate the learner's ontologies.

According to Osborne, Bell, and Gilbert, (1983:2), the teacher could try to do this by selecting examples that are common and non-contradictory by the learner's ontology in his or her class. For example, a shop sells girls' shirts at a discount of 15%. Pretty wants to buy a pair of shirts marked R150-00. She only has a R100-00 note in her purse (DBE 2020:2).

- a) What is the price of the shirt after the discount?
- b) Will she be able to buy the shirt?
- c) How much more money does she need before she can do so?

Answers

a) 15% of R150

$$\frac{15}{100} \times \frac{150}{1}$$

$$\frac{45}{2}$$

R22, 50

Discounted price for the shirt = R150 – R 22, 50

$$= R127, 50$$

b) No

c) Pretty needs R27, 50 to buy the shirt.

Figure 2.7: Answers for 15% of R150

2.2.4 The epistemological standpoint of bricolage

The epistemology of bricolage is based on multiple perspectives where knowledge construction is complex and grounded on multiple views (Denzin & Lincoln 2000:20; Prediger 2010:73, Carol & Burke 2010:5). Since knowledge is shaped by social theory (Kincheloe, 2005:326), different learners have different approaches to the construction of knowledge that is based on their context. It is therefore important that the teacher should use the learner's context to accommodate learners in the process of knowledge construction, that is the teaching and learning of common fractions. For example, the teacher should use examples that are in the learner's context to teach or ask questions. For example, there are 90 learners in the Grade 7 class, $\frac{4}{10}$ of the Grade 7 learners can afford to pay money for a farewell function. How many Grade 7 learners can afford to pay for the Grade 7 farewell function? How many learners did not pay for the function? Questions of this nature, demonstrate problem-solving skills in common fractions. Learners can demonstrate skills such as changing word sums to written mathematical expressions correctly.

It should be noted that different people have different ways in which they make sense of the world around them. This means that learners should be allowed to make sense of common fraction concepts, based on their historical and cultural background, during the teaching and learning of common fractions.

2.2.5 The role of the researcher

My role as a researcher is to act as a facilitator that will create conducive conditions for the co-researchers to work cooperatively and collaboratively in generating data in pursuit for the strategy to enhance teaching and learning of common fractions using a context-based approach. Teachers and learners as the co-researchers are the ones who are at the centre of this problem of teaching and learning of common fraction concepts; as a result, gathering of readily available information from them as a bricoleur researcher takes less effort. Kincheloe (2011:220) and Bradbury-Jones and Taylor, (2015:161) support this by arguing that co-researchers are the ones who understand their problem better and they are the ones with the solution to their problem. It is therefore important for me as the researcher to create a space for us (the co-researchers) to put together multiple sources of knowledge to transform the teaching and learning of common fraction concepts using a context-based approach.

2.2.6 The relationship between the researcher and the co-researcher

As Given (2008:788) and Sawyer (2010:14) indicated, the researcher and co-researchers work collaboratively in trying to uncover the context of the research and their relationship is based on mutual understanding, respect and dialogue. In my view, during the teaching and learning of common fractions, the teacher and learners are working as partners. It is important that the co-researchers develop trust in me as the researcher so that they could feel free to maximise their contribution during the research process. This requires de-empowerment on my side as the researcher to permit the co-researchers to work as equals during the development of a framework (Boog 2003:425; Kemmis, & McTaggart 2006:460, 2007:272). According to) and, team members should be called co-researchers. Co-researchers are active providers of research and participate at all times of the research process (Hooley, 2005:70; Mceleli, 2019:141)

Since the research participants are the ones with the problem, they are at the centre of the research activity; hence they are called co-researchers (Boog,2003:425; Kemmis & McTaggart 2007:272). This means the co-researchers are the ones who know and understand their problem. According to Kemmis (2006:460), the researcher can only

sensitise the co-researchers to re-look into their problem. Similarly, the learners and teachers are at the centre of the problem of teaching and learning of common fraction concepts since they have the first-hand information about the problems that they encounter. Teachers and learners are, therefore, the co-researchers in this study.

In a similar vein, this indicates that the researcher shows respect for the complexity of meaning-making by allowing co-researchers as the people who had better knowledge of the problem to be the driving force of the research process (Mahlomaholo 2012:25). The co-researchers and I also had the duty to work together and use an approach that will level the inherent power differentials that each co-researcher could bring to the team. This practice will ensure that we work as equals in the process of co-construction of knowledge during the development of the framework (Mahlomaholo 2012:15) to enhance teaching and learning of common fraction concepts using a context-based approach. Kincheloe, (2011:174) states a similar view that the teacher's role is not to be the source of information but to work hand in hand with learners in the construction of knowledge.

2.3 DEFINITIONS OF OPERATIONAL CONCEPTS

In this section, the definition of operational concepts will be discussed, derived from the title of this project. The aim of defining the operational concepts is to make it easy for the readers to understand the study. The concepts are as follows: context-based approach, teaching and learning of common fractions.

2.3.1 Context-based approach

Yu, Fan, and Lin, (2015:1383) define a context-based approach as an approach where the teacher is using examples that are drawn from the real-life situation to enhance the understanding of common fraction concepts during teaching and learning of these concepts. For example: During black Friday, all items are marked 50% down. What will you pay if you buy the following items, jean originally priced R300-00, shirt R30-00? (Glynn & Koballa 2005:75). When using this approach, the teacher uses skills from the real-world context in an attempt to accommodate learners from diverse backgrounds. Kumaradivelu (2001:541) adds that when this approach is used, learners interact with concrete materials and they are actively engaged. According to Kumaradivelu (2001:541), this results in learners, being motivated that the teaching and learning of common fractions will become meaningful to them. For example, some learners manage to see that 50% is half. Then they simply get half of R300-00, which is equal to R150-00 and half of R30-00 which is R15-00. Then the learners

manage to add R150 and R15-00, which is equal to R165-00. While other learners use rules and procedures, starting by adding $R300+R30 = R330$. Thereafter $50\% = \frac{50}{100} \times \frac{330}{1} = R 165-00$.

2.3.2 Teaching and learning of common fractions

Teaching refers to a method of acquisition of knowledge or skills by different learners to enhance the understanding of common fraction concepts during the teaching and learning of common fractions using context-based approach (Saxe, Shaughnessy, Shannon, Langer-Osuna, Chinn, & Gearhart 2007:222). For instance (Refer to Figure 2.8), three learners share one loaf of unsliced bread equally. What portion does each learner get from the loaf of unsliced bread? In addition to this, the example below emphasises sharing that leads to learners' understanding that $\frac{1}{3}$ is a fraction, where, 1 is the numerator, and 3 is the denominator.

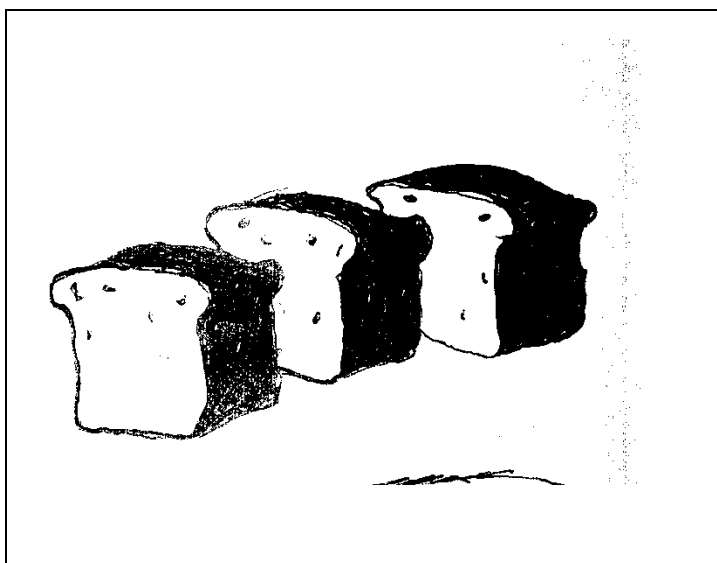


Figure 2.8: Unsliced loaf of bread divided into three equal parts

Shumba, Mporu, Seotlwe and Montsi (2011:1), in their work, posit that teaching is geared towards problem-solving, skills acquisition and self-knowledge, which requires the teacher to have these skills and knowledge during the teaching and learning of common fractions. Coe, Aloisi, Higgins, and Major (2014:31) emphasised the importance of the teacher possessing sufficient knowledge in common fraction concepts and multiple teaching methods to cater to

the diverse nature of learners. I, therefore, agree with Silverman and Thompson (2008:501) who argue that teachers who are successful in their teaching are the ones with the organised knowledge bases to quickly and easily draw upon while being engaged in the act of teaching and learning of common fraction concepts.

Jordan *et al.* (2013:49) define learning as a change in behaviour. On the other hand, the work of Mayer (2009:8); Dhlamini, Kibirige (2014:237) and Richardson (2005:3), defined constructivists' learning as learning that required learners to be actively involved as well as having hands-on experience during teaching and learning of common fractions. These definitions suggest that learning is the gaining of knowledge through the process that involves a stimulus that leads to a change in behaviour. My approach to teaching and learning of common fractions is based on the definition of learning as an activity where a learner is engaged in the process of attaining knowledge. They are actively involved in the process of knowledge construction during teaching and learning of common fractions, building on the pre-knowledge that they gained from their context.

2.4 REVIEW OF RELATED LITERATURE

This section deals with a review of related literature for designing a strategy to enhance the teaching and learning of common fractions using a context-based approach. Literature from South Africa, the southern African Development Community (SADC), Africa and the United States of America (USA) will be reviewed.

2.4.1 Need to enhance teaching of fractions

This section reviews the literature, firstly justifying the need for the study. Secondly, the literature is reviewed to gain an understanding of the solutions that respond to the identified challenges in the teaching and learning of common fractions. Thirdly, to determine the conducive factors that enhance the context-based approach for the teaching and learning of common fractions. Fourthly, to determine threats that might derail the context-based approach, and lastly, to share indicators of success that the context-based approach yield in enhancing the teaching and learning of common fractions for Grade seven learner.

2.4.1.1 *Challenges in calculating common fractions*

Common fraction concepts have proven to be one of the most challenging sections in mathematics in most parts of the world (Shin & Bryant 2017:77). Primary school mathematics results in South Africa revealed that learners are having trouble with the addition, subtraction,

multiplication and division of common fractions (Brown & Quinn 2007:8; Mdluli 2013:22) Studies conducted by Conley (2014:340) and Fazio and Siegler (2010:6) in Australia added that learners have experienced challenges in dealing with common fraction concepts. This was reflected when learners struggled to add fractions. Lumpkin, (2004:5) in Egypt shares the same sentiment about learners usually committing mistakes when adding fractions, especially those with different denominators. According to scholars, one of the reasons that contribute to the learners' difficulty in understanding common fraction concepts is what bricoleurs refer as a monological and deductive way in which teachers use to teach these concepts (Rocci 2005:102).

In addition, teachers' ontological beliefs contribute to the way the teacher teaches common fraction concepts (Duit & Treagust 2003:677). For example, the teacher with a realistic worldview can only transmit their known knowledge to the learners. Alluding to this, Mdluli (2013:2) argue that learners fail to make calculations because teachers are using rules and procedures that are taught without context or concepts, which results in algorithms that are ungrounded and only mastered through memorisation. This can mean that the teachers are disregarding learner's pre-knowledge which bricolage regards as a tool to construct knowledge of common fraction concepts (Rogers (2012:3). As Brown and Quinn (2006:30) pointed out, this approach limits the opportunity for the learners to discover things for themselves. As Phillimore *et al.* (2016:7) argued, learners' conceptions are based on learners' experience, which means the teachers should allow learners to play around and test their pre-knowledge in common fraction concepts.

According to Kirschner, Sweller, and Clark, (2006:75) and Bale, (2006:49) learners should be taught in such a way that they should discover rules and procedures themselves. This helps the learner to develop procedural fluency, which is one of the strands that is required for mathematical proficiency. According to Kilpatrick *et al.* (2001:121), procedural fluency is the knowledge of procedures and skills that the learner has about common fraction concepts and the knowledge of when and how to apply them appropriately. This assists learners to develop a deeper understanding of the addition and subtraction of common fractions.

In the same breath Mdluli (2013:22) and Bruce and Ross (2009:12) reveal that the common mistake that the learners commit when adding common fractions was to add a numerator to a numerator and the denominator to a denominator. For example $\frac{2}{3} + \frac{1}{3} = \frac{3}{6}$ and $\frac{1}{4} + \frac{3}{6} =$

$\frac{4}{10}$ ". A similar mistake was committed by learners when subtracting common fractions. For instance $\frac{5}{4} - \frac{1}{4} = \frac{4}{0}$, they subtract the numerator from the numerator and the denominator from the denominator.

In addition, Wu (2001:175) states that the lack of procedural proficiency leads to poor conceptualisation of the addition and subtraction of common fractions. From the above argument, one may conclude that learners who commit these mistakes lack the conceptual understanding of the addition and subtraction of common fractions (Brown & Quinn 2006:30).

According to Tchoshanov, (2011:145), the conceptual understanding of common fractions refers to an integrated and functional grasp of ideas about common fraction concepts. Arguing this further, Brown and Quinn (2006:30) aver that this results in learners opting to use the same procedures for solving both common fractions and natural numbers. Mdluli (2013:51) shares the same sentiment that this error emanates from the teachers' approach of transmitting rules and procedures to learners when teaching common fraction concepts.

In pursuance of this, Brown and Quinn (2006:29) posit that teachers emphasise the memorisation of rules and procedures without a conceptual understanding of common fractions. Hence, learners lack procedural fluency in the addition and subtraction of common fractions.

In addition, the work of Brown and Quinn (2006:36) has further brought another error that learners commit when dealing with common fraction concepts to our attention. According to Brown and Quinn (2006:36), learners assume that the fraction with the biggest denominator is the biggest fraction when ordering fractions. For example, given the following fractions to be arranged in ascending order, $\frac{1}{3}, \frac{1}{6}, \frac{1}{8}, \frac{1}{2}$, they tend to order them in the following order $\frac{1}{2}, \frac{1}{3}, \frac{1}{6}, \frac{1}{8}$. Courey, Balogh, Siker and Paik (2012:252) revealed that learners are influenced by the whole number concept and as a result, they arrange fractions according to the biggest denominator. As far as Courey *et al.* (2012:253) are concerned; this indicates that these learners did not define the role of the units before comparing fractions with different denominators. This reflects an incomplete understanding of common fraction concepts.

As Alghazo and Alghazo (2017:133) and Dhlamini and Kibirige (2014:236) pointed out, miscalculation remains a problem in the teaching and learning of common fraction concepts, despite the teachers' attempt to make these concepts more understandable. Similar to the

addition and subtraction of common fractions, this problem can be traced from the approach that the teachers use when teaching these concepts (Knifong & Holtan, 1976:110). Teachers concentrate more on the rules and procedures that are involved in these concepts rather than conceptualising common fraction concepts (Knifong & Holtan, 1976:111). This makes it difficult for learners to develop a conceptual understanding of these concepts, and learners then opt to memorise algorithms that are ungrounded and are mastered through memorisation.

However, in South Africa, mathematics results in primary school revealed that learners are experiencing difficulties in adding, e.g. $\frac{1}{2} + \frac{1}{2} = \frac{2}{4}$. Learners add numerators and denominators, and in subtraction, they did the same thing, e.g. subtracting $\frac{4}{5} - \frac{1}{3} = \frac{3}{2}$ (Mdaka 2013:31). They did not find the lowest common denominator. Arguing this, Tchoshanov (2011:145) posits that finding the lowest common denominator helps to express these fractions in the same denominator, which makes it easy for the learners to add or subtract them. Multiplying, $\frac{1}{2} \times \frac{1}{5} = \frac{2}{10}$ and dividing $3 \div \frac{1}{2} = \frac{2}{3}$ (In multiplying learners perform poorly introducing procedures from other fractions into fraction multiplication, by adding numerators and multiplying denominators). This leads to errors such as $\frac{1}{2} \times \frac{1}{5} = \frac{2}{10}$ in which numerators are added, and denominators are multiplied. While in division, learners change both fractions, denominators become numerators, and the numerators become a denominator. This leads to errors such as $\frac{3}{1} \div \frac{1}{2} = \frac{2}{3}$ (Brown & Quinn 2006:28; Molebale 2005:17).

2.4.1.2 Addition involving common fractions with different denominators.

Learners often encounter problems in adding common fractions with different denominators (Ghani & Maat 2018:112). Baroody and Hume (1991:60); Duzenli-Gokalpa and Sharmab (2010:5169); Courey *et al.* (2012:253) argue that learners have challenges in adding common fractions with different denominators. For instance $\frac{1}{3} + \frac{3}{4} = \frac{1}{3} + \frac{3}{4}$ According to Duzenli-Gokalpa and Sharmab (2010:5169) and Courey *et al.* (2012:253) these challenges reflect learners' lack of understanding of arithmetic operations on common fractions and algorithms for computing fractions. This is prominent when learners are adding numerators and denominators together which indicates that the whole number concept has influenced learners, they apply the knowledge of adding whole numbers, e.g. $1 + 2 + 3$ to add common fractions (Branch 2016:6; Brown 2014:1; Torbeyns, Schneider, Xin, & Siegler 2015:5). The memorisation of rules and procedures hinders deep conceptual understanding of common

fractions Mdluli (2013:53). According to Newton (2013:2) and Olanoff et al,2014:289), when learners' knowledge is rote or insufficient, learners tend to over generalize the rules and procedures; hence they apply the same rules in common fractions as in whole numbers (Lithner 2015:488; Sonawat & Kothari 2013:49). As stipulated in bricolage, learners should be allowed to discover the approach to use to solve common fractions rather than passively receive it from the teacher in the form of rules (Singh 2006:34). This makes it difficult for learners to develop a deeper understanding of common fraction concepts.

2.4.1.3 *Learning styles as a challenge in teaching common fractions.*

One of the challenges in the teaching and learning of common fractions is the way teachers' use the teaching and learning modalities (Pashler *et al.* 2008:105). Teaching and learning modalities occur when the teacher uses different resources or modes such as counters, fraction circles, Cuisenaire rods, paper folding, and paper-and-pencil (Radford, 2009:111). Modalities play an important role in engaging learners in the active construction of common fraction concepts. The work of Chahine, (2013:436) concurs that the teaching and learning modalities enable the learners to build appropriate mental models that empower the learner to develop a deep understanding of common fraction concepts during teaching and learning. The teachers' use of teaching and learning modality is not at an adequate level (Urista 2011:1). This means, sometimes the teachers can use these modalities incorrectly, which results in learners forming misconceptions. Alternatively they can use them correctly, but limit it to a specific group of learners whose learning styles are accommodated. This marginalises those learners' whose learning styles are not accommodated in the teaching and learning of these concepts.

According to Klašnja-Milićević, Vesin, Ivanović, and Budimac, (2011:886), the word learning styles refer to the different ways in which diverse learners learn the content of common fractions. These include visual learning, where a learner learns best by seeing things, auditory learning where the learner learns better by listening, kinesthetic learning where a learner learns better by touching things, that is doing something for herself/himself (Urista 2011:4). According to methodological bricolage, this is the multiple approaches to the teaching and learning of common fraction concepts, that allows for the learners' diversity (Hwang, Shadiev, Tseng & Huang 2015:464; Kincheloe 2005:335O'Regan 2015:459; Rau *et al.* 2009:441; Rogers 2012:4;).

Furthermore, the teacher could verbally explain to the learners the steps that are involved in subtracting common fractions (Willingham 2005:31). Then the teacher further draws a fraction wall diagrams to enhance learners with understanding that show learners how many quarters in a half and noticed what happened if they take a quarter from two quarters (Willingham 2005:31). This could assist in accommodating different types of learners in the teaching and learning of common fraction concepts. For instance

$$\frac{1}{2} - \frac{1}{4}$$

$$\frac{2-1}{4}$$

$$\frac{1}{4}$$

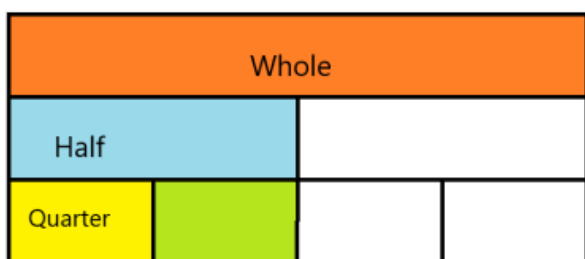


Figure 2.9: : Demonstration of mixed fractions

$$\frac{1}{2} - \frac{1}{4} = \frac{1}{4}$$

(Sibanda 2015:141)

Orange = 1

Blue = $\frac{1}{2}$

Yellow = $\frac{1}{4}$

Green = $\frac{1}{4}$

Blue - yellow = green, meaning that $\frac{1}{2} - \frac{1}{4} = \frac{1}{4}$

Figure 2.9 demonstrates that $\frac{1}{2} - \frac{1}{4} = \frac{1}{4}$. Learners in the above diagram it can be seen that the half presented by the colour blue is composed of two quarters presented by yellow and green.

However if you take one quarter you can remain with quarter again (Desta 2019:39); Moyer (2001:176) went beyond this to argue that learners who are taught using both procedures and representations understand better and their performance improved as compared to the learners who learnt from one approach.

Pashler *et al.* (2008:105) further add that learners' experiences pose a challenge to the understanding of common fractions due to the teacher's approach who teaches without using different learning styles to accommodate different learners; as a result, learners experience difficulties in understanding common fractions. From the epistemological viewpoint, this allows the teacher to accommodate learners' perceptions and views in common fraction concepts (Russ 2018:95). According to Courey, Balogh, Siker and Paik (2012:258), this is a bricolage approach to the teaching and learning of common fractions, which allows the teachers to accommodate different ways in which the learners can make sense of these concepts.

In addition, Barr (2011:25) argue that another challenge that contributes to the learners' problems in understanding common fractions is the teacher-centred approach which allows the teacher to explain the content to the learners and the learners are passive receivers of the information (Choudhary, Dullo, & Tandon 2011:42). According to Chen and Zhang (2008:305). in this teaching strategy, learners are fed with information and this teaching strategy benefits only auditory learners and marginalises other learners with different learning styles. According to Allcock, Landshire, and Hulme (2010:2), if the teacher is teaching without using different teaching strategies, the teacher is neglecting different learners' intelligence when planning their lesson by failing to include activities that cater for different types of learners in the class. Dole, Bloom and Kowalske (2016:9) argue further that this affects learners whose learning style are not catered for, and deprives learners the opportunity to engage in critical thinking.

2.4.1.4 Pedagogical Content Knowledge (PCK) as a challenge in teaching

PCK is the knowledge possessed by the teacher about the content and teaching strategies that incorporate appropriate conceptual representations, to address learner difficulties and misconceptions and to foster meaningful understanding (Shulman, 1987:4; Park & Olive 2008:264; Sibuyi 2012:9; Bausmith, Merriman & Barry 2011:176 & Olanoff *et al.* 2014:269). PCK play an important role in the teaching and learning of common fractions (Forrester & Chinnappan 2010:185). Inadequate PCK can have an adverse effect on the teaching and

learning of common fraction concepts (Banks 2019:26). These include the formation of alternative conceptions in learners due to the use of imprecise fraction language when teaching these concepts (Bransford, Brown & Cocking 2000:24). For example “four-fifths” reading as “four over five, lead learners to understand it as “four fives”. (Jigyel, Afamasaga-Fuata’i 2007:20; Olanoff 2014:2740) attribute this to the lack of pedagogy and content knowledge. From Beak, Wickstrom, Tobias, Miller, Safak, Wessman-Enzinger, and Kirwan (2017:4) point of view the teacher with inadequate PCK is not at an adequate level of using these multiple naming strategies of naming common fractions. This inhibits conceptual understanding of common fraction concepts in learners as a results misconceptions are formed.

According to Alexakos, (2015:4); Park, (2012:56) and Bratkovich, (2019:120) from bricolage perspective, the teacher with adequate PCK possesses different and multiple approaches that can be used to enhance teaching and learning of common fraction concepts. This involves and accommodates different learners in the process of knowledge co-constructions about these concepts.

Amplifying this notion, Bransford *et al.*, (2002:24) suggested the teachers’ use of pictures and the manipulatives to introduce common fraction concepts. This assists the teachers in approaching teaching perceptually and figuratively. “Perceptually” means the way learners perceive it, while ‘figuratively’ indicates learners using figures (Nissim 2020:27). According to Piaget (1977:5), nevertheless, the figurative aspect of knowledge is based on shapes, which are observable. For example, half of a rectangle can be either rectangular or triangular. While the triangular half may look bigger than the rectangular half from a figurative point of view, our operative knowledge enables us to deduce that the two halves have the same area (Kamii, & Clark 1995:369). On the other hand, perception is the body, identification, and interpretation of sensory information to represent and understand the presented information of common fractions (Norwich, 1987:287; Norwich 1993:1; Abtahi 2018:276)

Contrary to Idris and Narayanan (2011:37) who confirm that in this teaching, the concepts formed by the learners about common fractions remains mainly figurative and this inhibits the learners from learning to reason about common fraction concepts. Beak *et al.* (2017:5) argue further that this type of teaching will provide the learners with limited views of common fraction concepts, and this may cause limiting construction to learners. Ni and Zhou (2005:28) define limiting construction as a situation where learners are provided with limited views of common

fraction concepts. In limiting construction, they can use an example or representation that can hinder the learner from thinking deeply about the concept, e.g. only dealing with halves and quarters for some time before introducing thirds to learners. D'Ambrosio, and Mewborn confirmed this (1994:155); while Ni and Zhou (2005:28) argue that limiting construction of knowledge in common fraction concepts can hinder the development of knowledge about common fraction concepts.

2.4.2 Solutions to enhance effective teaching of common fractions

This section will discuss the core components of the solution to answer to the needs deliberated in Section 2.4.1. This component consists of an understanding of common fractions, using manipulations to enhance understanding of common fractions, teaching and learning modalities, relevant PCK of common fractions. These components are discussed below.

2.4.2.1 Understanding of common fractions

Fractions create an obstacle in teaching and learning for both teachers and learners (Gabriel, Coche, Szus, Carette, Rey, & Content 2012:137). This may result from the misconceptions that the teachers themselves held about common fraction concepts, which carried over to the learners (Newton 2008:1082). Mutsvangwa, (2016:4) shares a similar view about this misconception, where the learners assume that the fraction with bigger denominator is bigger. For example, $\frac{1}{10}$ is bigger than $\frac{1}{2}$ just because denominator 10 is bigger than denominator 2 (Akson & Yazlik 2008:219; Wu 2013:8). As stated in bricolage, it is therefore important for the teacher to possess deeper knowledge as a tool to alleviate the misconceptions in common fraction concepts. According to Kara, Melike, Simon and Placa (2018:1) this helps the teacher to understand learners' misconceptions and find the relevant strategy to deal with them. In support of this notion Gabriel *et al.*, (2012:137) posit that to improve the understanding of division of fractions among learners, the teacher must use more activities based on learning-by-doing activities. Chen, Jie-Qi, Brownell and Uttal, (2018:55) argue further that the teacher should facilitate a process where the learners start off with concrete objects and gradually construct more abstract representations of common fraction concepts. This can be done by allowing playfulness and collaboration as a conducive environment when teaching common fraction concepts (Beak et al. 2017:5). Weisberg, Hirsh-Pasek, and Golinkoff (2013:104) confirm that the teacher can do this by encouraging learners to become active participants in the teaching and learning of common fractions.

Arguing this further Anthony and Wilshaw (2009:109) state that, for the subject matter to be meaningful and understandable to learners, the teacher has to integrate the teaching and learning of common fractions with prior knowledge of the learners. According to Ni and Zhou (2005:28), pre-knowledge is the knowledge that learners bring to school, which contains rich knowledge that is based on learner's day-to-day experience, and it can help to enhance the understanding of common fraction concepts. This also help to stimulate the learner's interest and attention so that, learners can become actively involved in the teaching and learning of common fractions. Meaning that if the learning of common fractions is contextualised using the experience of the learner, it will be easy for the learner to move from concrete to abstract to comprehend (Pellet, Jean-Philippe, Parriaux & Overney 2018:42). Considering the experiences and surroundings of the learners, (Barnes 2004:59) suggests that, the teachers should start their teaching by using realistic problems For instance, if there are two learners to divide one orange, then there will be a half for each learner, and if there are three learners, each learner will receive one-third etc.

According to Barnes (2004:50) and Doorman (2002:9), using realistic problems can assist in contextualising the teaching and learning of common fraction concepts. This means using a context-based approach that involves common fractions to solve different problems can encourage learners to invent their own solutions, and the concept of common fractions will develop in learners' minds (DBE 2011:17). This is also concurred by Siegler *et al.* (2010:33) that real-world contexts can awaken learners' intuitive problem-solving abilities for computing common fractions. DBE, (2011:9) further suggests that, for the learners to conceptualise the common fractions content meaningfully, teachers have to take into consideration the intuitive understanding of fractions that learners bring to school. The NCS and the Curriculum and Assessment Policy Statement (CAPS) state that mathematics, in particular fractions, is markedly a human activity practised by all cultures (DOE 2003:9). Hence, common fraction problem solving enables us to understand the world around us and make use of that understanding in our daily lives (Mwakapenda 2008:191).

2.4.2.2 *Using manipulations to enhance understanding of common fractions*

From the methodological bricoleurs' approach, the teacher can use manipulations to contextualise the teaching and learning of common fractions, to enhance the learners' understanding of these concepts (O'Regan 2015:459; Rogers 2012:4; Kincheloe 2005:335). This demands the importance of the teachers to use different modalities to accommodate learners' ontological and epistemological views of these concepts (Kelly 2013:5). In

pursuance of this Empson (1995:110); Murray, Human and Olivier (1996:43) suggested that common fraction concepts should be introduced to learners by contextualising the situation. For instance, the situation in which the number of objects is more or less than the number of friends. Since learners are very fond of fair sharing, the teacher can take advantage of that by giving those objects that are more or less than their number to share equally amongst themselves. The learners will try to solve their real-life problem using the knowledge that they have about dividing an object equally. For instance, learners can share three chocolate bars equally between their two friends during Valentine's Day. Then each friend can get one chocolate and divide one left into two pieces. By doing so, each friend would get one chocolate and half chocolate.

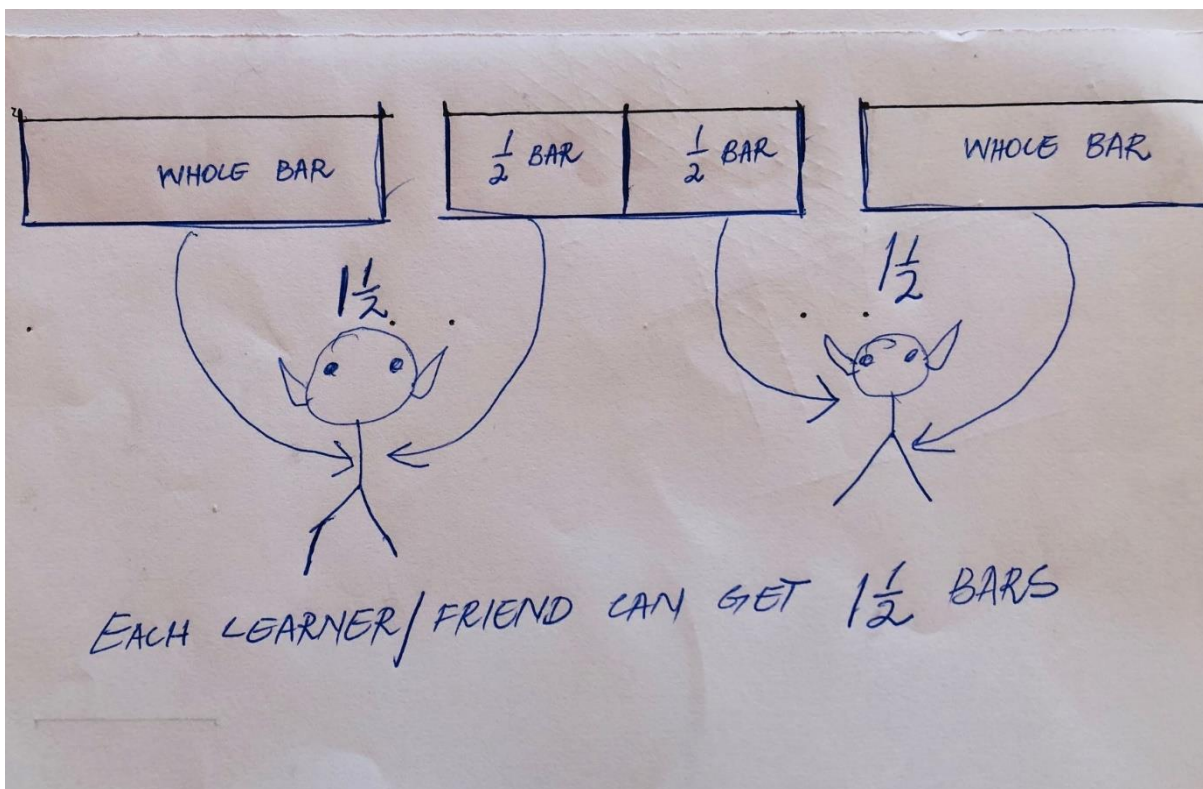


Figure 2.10: Demonstration of 2 learners sharing 3 bars of chocolate

On top of that, the teacher can put three equal pieces of chocolate and on the table and ask five learners from the class to come and share those three pieces equally. This will give learners a chance to create their own representations of fractions, and by so doing, conceptual understanding of common fraction concepts could be developed. Teachers can deepen learners' understanding of common fraction concepts by contextualising their teaching and learning (Pellet, Jean-Philippe, Parriaux & Overney 2018:42). This can be done

by explaining the manipulations in the learners' context. This could be achieved by allowing learners to do partitioning and iterating (Neagoy, 2017:11; Thambi & Eu, 2013:98). For example, partitioning is the process of dividing the whole into smaller equal-parts:

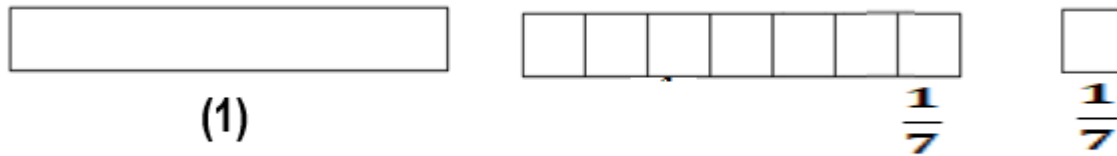


Figure 2.11: Partitioning of common fractions of a whole

(1) to $\frac{1}{7}$

Through partitioning, learners construct division of fractions. They may count ‘1 one-seventh, 2 one-seventh’s, 3 one-seventh’s, 4 one-sevenths, 5 one-seventh’s, one-6 one-seventh’s and 7 one-seventh’s when making the whole from the unit fraction (Bruce *et al.* 2013:34; Siebert & Gaskin 2006:395). On the other hand, iterating means the process of assembling different smaller equal-parts into a whole. For instance, as depicted in Figure 2.12.

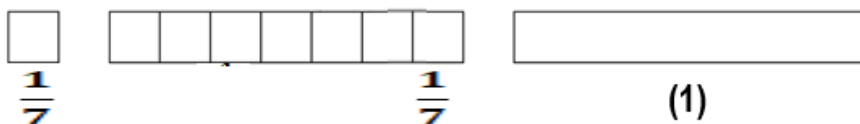


Figure 2.12: Iterating of common fractions

$\frac{1}{7}$ to a whole (1)

The engagements of partitioning and iterating empower learners to understand by doing. To my way of thinking, they act as bricoleurs, because they use tools at hand to add, subtract, multiply and divide. Therefore, the work of Bruce *et al.* (2013:34) posits that learners could be able to demonstrate by showing an understanding of the appropriate use of the operations. By so doing, learners should develop a deeper understanding of common fraction concepts.

Hence partitioning and iterating play an important role in constructing a conceptual understanding of common fractions (Bruce *et al.* 2013:34; Wilkins & Norton 2018:27).

Thus, this makes it easy for the learners to apply all four mathematical operations, addition, subtraction, multiplication and division of common fractions with success. Kolar, Cadez, and Vula (2018:81) add that partitioning and iterating help to mitigate learners' 'misconceptions in common fraction concepts.

On the other hand, Neagoy (2017:11) define partitioning as a method of giving learners the whole and allow them to divide it into equal parts and iterating as take parts and assemble them to make whole. Nyathi (2013:2-3) argue that when using a problem-solving approach during teaching and learning of common fraction concepts, the lesson becomes more learner-centred. Thus it provides an effective way for the learners to represent their thinking. Mdluli (2013:37) and Fazio and Siegler (2011:12) further emphasise the importance of using a concrete object to build learners' understanding of common fractions by using rectangular manipulation that actively involves learners in addition, subtraction, multiplication and division of common fraction concepts. According to Thambi and Eu (2013:105) this action is based on social constructivism theory since learners use rectangular manipulation and work together in the process of knowledge co-construction about common fraction concepts. According to Fairchild (2012:2) and Clements, (2004:10) the use of manipulations can assist learners in demystifying the confusion behind finding the common denominator when adding or subtracting common fractions. For example, the following diagram shows the fraction wall that demystifies learner's confusion in sizes.

1					
$\frac{1}{2}$			$\frac{1}{2}$		
$\frac{1}{3}$		$\frac{1}{3}$		$\frac{1}{3}$	
$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$

Figure 2.13: Demonstrating mixed fractions

$$\frac{1}{2} + \frac{1}{3}$$

Where $\frac{1}{2} = \frac{3}{6}$ Refer to Fig 2.14

$$\frac{1}{3} = \frac{2}{6} \text{ Refer to Fig 2.14}$$

Therefore $\frac{1}{2} + \frac{1}{3}$

$$\frac{3}{6} + \frac{2}{6}$$

$$\frac{5}{6}$$

2.4.2.3 Teaching and learning modalities

Teaching and learning modalities

According to interpretive bricolage, there is no one correct way of telling of an event (Rogers 2012:4). This makes it necessary for the teacher to use different teaching and learning modalities to cater to the learners' diversity and different ways in which the learners make sense of common fraction concepts. According to Yassin and Almasri, (2015:26) different learners have different contexts; hence, they have different learning styles, which they retain even if it does not match with their teachers' teaching style. As Yassin and Almasri (2015:26) and Tuan (2011:290) states, it's therefore important for the teacher to use different teaching strategies during the teaching and learning of common fractions to accommodate different learners' learning styles (Chahine 2013:436). For instance, in addition to a verbal description,

the teacher could use manipulatives and other representations to concretise the teaching and learning of common fraction concepts. This procedure can assist in accommodating the different ways in which learners could develop the understanding of these concepts (Dunn 1990:225; Reid, 1987:90 & Willington 2005:3). Dunn (1990:225) posit that learners learn better if the teachers' instructional strategies match the learners' learning styles.

In addition, the teacher can use groups to encourage sharing and co-operative learning (Chahine 2013:436). In this approach, learners work in collaboration under the guidance of a teacher and share knowledge and problems that they have with regards to common fractions in order to scaffold their individual knowledge (Leong 1998:13; Meyer 1993:45). According to Vygotsky, (1978:78), "scaffolding" occurs when the learner learns more by working with a teacher or a more able learner to attain a deeper understanding of common fraction concepts. Alluding to this Ozan, (2013:50); Simonin, (1997:1155) posits that learners learn more when collaborating with others who have a wider range of skills and knowledge than the learner currently has. This can assist in minimising misconceptions that learner has about these concepts, and this indicates the success of the strategy in developing an understanding of common fractions (Fani, & Ghaemi 2011:1549).

According to Pashler *et al.* (2008:113), and Willington (2005:3), it is important for the teachers to tailor their teaching instructions to their learners' learning styles. This helps to improve the learners' understanding of common fractions and makes it enduring (Tian, & Siegler 2018:351). The work of Ainsthworth (2006:18) emphasized the importance of the teachers to vary their teaching modalities by using auditory, visual and kinesthetic learning in order to accommodate the diverse way in which learners construct knowledge of common fractions. Amplifying this notion Awla (2014:242), Dunn (1990:225); Reid (1987:87) posited add that, the teacher must use the modality that is in line with the learner's preferred style of teaching in order to accommodate his or her learning style. Following the same line of argument Liu, Stamper, Davenport, Crossley, McNamara, Nzinga, and Sherin (2019:109) argued further that even learners who were struggling with the understanding of common fraction concepts would have their understanding of the concept enhanced if this approach was used.

2.4.2.4 *Relevant Pedagogical Content Knowledge of common fractions*

PCK is the knowledge that is possessed by the teacher about common fractions content, relevant teaching strategies, misconceptions carried by learners in common fraction concepts and how to deal with them, and subtopics in common fractions and their degree of difficulty

(Ball et al. 2005:16; Ramdhany 2010:ii; Shulman 1986:9). The work of Ball, Hill, and Bass, (2005:16) suggested that for the teacher to be successful in teaching and learning of common fractions, the teacher should possess adequate PCK. Adopting theoretical bricolage, the teacher should possess the knowledge of working between teaching strategies to accommodate diverse ways in which learners construct knowledge of common fraction concepts. According to Puteh and Kathirveloo (2016:3), PCK plays a significant role in the teacher's attempt to enhance conceptual understanding of common fraction concepts. In addition, Silverman, and Thompson (2008:501) pointed out that PCK assists the teacher in identifying the conceptions that the learners have about common fraction concepts. Rahman and Scaife (2006:81); Freathy, Doney, Freathy, Walshe, and Teece, (2017:428) from bricolage perspective posit that PCK is an important tool for the teacher to help the learners to retrieve and recombine learners' conceptions with common fraction concepts for the learner to attain the state of conceptual change in their minds. Vamvakoussi, (2017:500); Tian and Siegler, (2018:355) define conceptual change as a state where restructuring of the knowledge occurs in the learner's mind, and as a result, concepts become meaningful to the learners.

Furthermore, the National Council of Teachers of Mathematics (NCTM) (2000:17) corroborates that PCK promotes the effective learning that is essential for planning and implementation of lessons during the teaching and learning of common fractions. In the same breath, Siegler and Fazio (2011:12); Chang, Lee and Koay, (2017:1) attest to the notion that for the teacher to assist learners in making sense of the content, PCK plays an important role in assisting the teacher in contextualising the lesson by concretising his or her lesson. Smylie and Wenzel (2006:7) and Moyer, Bolyard and Spikell (2002:272) argue that if the teacher is having adequate PCK in common fractions, the teacher will be able to choose manipulation that will enhance conceptual understanding of common fraction concepts rather than limiting instruction in learners' minds about these concepts. Furthermore, studies conducted in South Africa by Jita, Maree and Ndlalane (2008: 475) opine that teachers should be encouraged to work as a team, to share their ideas and experiences, which will assist them in enhancing their understanding of common fractions during teaching and learning of these concepts. According to Shulman (1987:15); Niess (2005:520); Park and Oliver (2008:165) posit that teachers require both content knowledge and pedagogical content knowledge to be successful in teaching and learning of common fractions. Ma (2010:882), Polly (2011:950) and Bowers and Stephens (2011:300) contend that the teacher with adequate PCK can let

learners discover things for themselves by stimulating curiosity during teaching and learning of fractions. The teacher can ask learners that given the scenario (Awla 2014:242), how could you share two pizzas equally among three learners (Wilson, Edington, Nguyen, Pescosolido & Confrey 2011:33). Then by doing that, he is trying to lead learners to discover the correct answer for themselves. The teacher enhances learners' informal understanding of fractions and helps to connect common fractions. By doing that, he is showing adequate PCK. Also, Suh *et al.* (2005:1); Biesta, (2009:35) share the same sentiment that these learners will demonstrate improvement in common fractions performance.

2.4.3 Conditions for improving teaching and learning of common fractions.

This section focuses on the conducive conditions that enhance the purpose of sustainable solutions and outlines the conditions that enhance the teaching and learning of fractions in grade 7.

2.4.3.1 *Conditions for proper teaching and learning of common fractions*

As stipulated in bricolage, the meaning-making task demands an appropriate approach that makes common fraction concepts meaningful to learners so that learners can develop a deeper understanding of these concepts (Bratkovich 2019:80; Litts 2015:9). DBE (2011:8); Brown and Quinn, (2006:37) and Newton, (2015:1104) share the similar view that deep conceptual understanding of common fractions is needed to make sense of common fraction concepts. According to Mdaka (2011:5), the teacher should start by tracing the mistakes that the learners have about common fractions and build on them in developing a deeper conceptual understanding of common fractions. This help to contextualise teaching and learning of common fraction concepts (Rogers 2012:1). This can be done by using learners' everyday experience to explain the concepts and give them work that involved their daily experience (Willingham 2005:31). For instance, book shopper decided to decrease stationary in January 2020 by 50%. By how much would the book shopper decrease the price of two writing pads costing R12-00, 72 pages, costing R6-00, and instruments, costing R50-00.

Alluding to this. Hajdu (1998:4) posits that these mistakes, such as writing R50-00 only, instead of $\frac{50}{100}$, also lead to an incorrect answer. As suggested by Uttal, Scudder, and DeLoache, (1997:37) and Thompson (1992:124), these mistakes can be stopped by using concrete objects so that learners can be able to discover rules for themselves (refer to Figure 2.14).

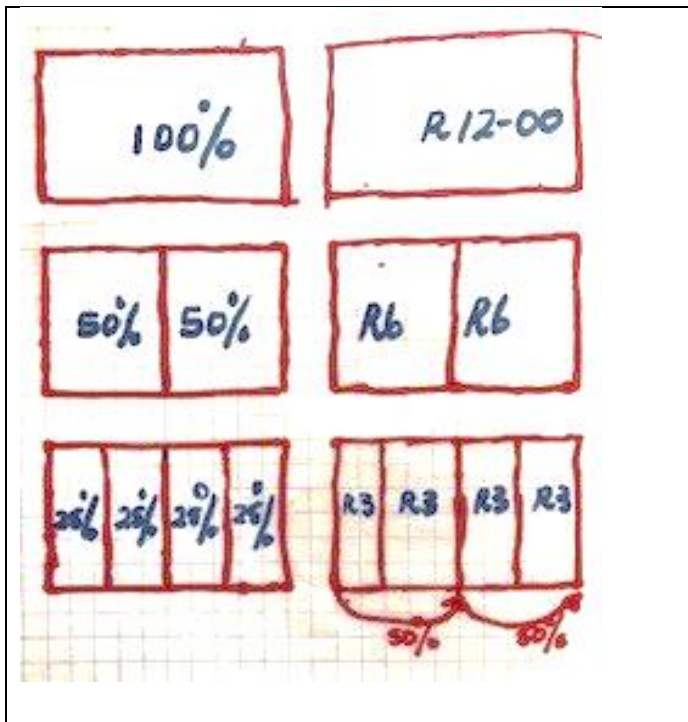


Figure 2.14: Demonstration of a concrete object (using percentage and money)

Mistakes such as, if it is 50% of learners that write it as $50 \times 12 = 600$ for the two quire. Hence, they further calculate $50 \times 6 = 300$ for 72 pages.

On the other hand, Pashler *et al.* (2008:109), Rittle-Johnson and Star, (2009:8) and Fazio and Siegler (2011:6) suggested that the teachers should use different teaching modes as the condition to be conducive to eliminate poor conceptualisation of common fraction concepts. By poor conceptualisation, meaning whereby learners memorise concepts without an understanding of those concepts. According to Molefe and Brodie (2010:4); Tchoshanov, (2011:145), this will allow learners to think and construct common fraction concepts meaning from the modes that suit best their learning style. Furthermore (Hurrell 2013:30) argue that this helps to link existing knowledge to that of fraction concepts to solve common fraction problems

2.4.3.2 Condition for effective use of concrete objects in the teaching and learning of common fractions

Effectiveness of concrete objects in teaching and learning of common fraction concepts depends on the way the teacher uses a concrete object to make the lesson more meaningful to the learners during teaching and learning of common fraction concepts (Samara, Julie &

Clements 2016:72; Uttal *et al.* 1997:40). Concrete objects are objects that help to make a connection between physical (concrete) world to the theoretical (abstract) world (Clements 2000:46). Kamina and Iyer (2009:5) aver that this aids a learner to make a connection from a tangible, concrete object to its abstraction. According to Fyfe, McNeil and Borjas (2015:104), using concrete objects can be one of the conditions that are conducive for the teaching and learning of common fraction concepts. Ravishankar and Gurca (2015:54) from bricolage perspective posit that a combination of multiple methodological practices and empirical materials can assist the teacher in developing a more in-depth understanding of common fraction concepts. According to Moyer (2001:180), this helps learners to interact with objects in their environment and allow them to construct abstract common fraction concepts. For instance, Snehlanhla prepares Oats for breakfast for her friends. For each bowl she uses $\frac{1}{4}$ of a litre of milk. If she made eight bowls of Oats, how many litres of milk did she use? The teacher as a bricoleur was able to use the material at hand to teach common fractions by using oats and milk. In Brown, McNeil, and Glenberg (2009:160); Clarke and Roche (2009:127) point of view, manipulatives provide an opportunity for the learners to construct knowledge about common fraction concepts and bridge a gap between concrete and abstract during teaching and learning of common fraction concepts.

Alluding to this (Hurrell 2013:33) posit that, teachers must use a rich representation that connects learners' pre-knowledge to abstract common fraction concepts so that these concepts become meaningful to the learner. According to Raven McCrory, (nd: 1) learners start as concrete thinkers; hence it is important for the teachers to use concrete objects in a manner that connect the learner to common fraction concepts. DoE (2014:41) believes that, correct usage of manipulations can assist in reversing misconceptions during teaching and learning of common fractions. This is further corroborated by the work of McNeil and Jarvin (2007:17) who argue that concrete objects assist learners in making a connection from real objects to its abstraction.

2.4.3.3 *Conditions for using teaching and learning modalities to enhance teaching of common fractions*

Another condition conducive for successful teaching and learning of common fractions that is suggested by different scholars is the use of teaching and learning modalities. This includes different teaching strategies and manipulatives. According to narrative bricolage, this help to avoid univocal representations of common fraction concepts (Rogers 2012:6; Markham, (2005:24). Pashler *et al.* (2008:105); Willingham, (2005:34) and Felder, (1996:18) share the

same sentiment that the teacher should use the variety of teaching and learning modalities to personalise instruction for learners. This means the teacher should try to teach in a manner that accommodates learners with different learning styles or preferred teaching and learning modalities or strengths when teaching common fractions.

Furthermore, Güryaya (2016:390) argues that for teachers to understand how to use teaching and learning modalities to teach common fractions, the teacher should go beyond knowing how to teach, to knowing how to learn. According to (Felder & Silverman 1988:675), to stimulate interest in common fractions, teachers should use teaching modalities that is based on learners' daily life experience and vary their modalities. For instance, food handlers made $\frac{2}{3}$ of porridge, if they put $\frac{1}{3}$ of curry soup into a bowl, how many bowls can food handlers fill? The teacher can allow learners to do the sum using any method that suits the learners to accommodate all learners that are in the class.

According to Siegler, Carpenter, Fennell, Geary, Lewis, Okamoto, Thompson, and Wray (2010:12) these include sharing some objects amongst themselves. Situ, (2013:10); further suggests that, for the teacher to instil curiosity in learners, the teacher should develop assignments, project and assessment strategies that link learners' knowledge and their life experiences. Teaching often reflects the teacher's preferred teaching style rather than learners' preferred learning styles. It is, therefore, important for the teacher to vary teaching and learning modes when teaching common fractions. Fleming and David (2006:2) posit that this could have been done to accommodate different ways in which learners acquire and process new information about common fraction concepts. These views lie on the assumption that learners learn better and more comfortably when they are actively involved in the teaching and learning process and when they have given supervision and feedback by their teachers (Belaineh 2017:696).

2.4.3.4 *Factors that enhance pedagogical content knowledge of fractions*

Possessing adequate Pedagogical content knowledge in common fraction concepts is one of the conditions that are conducive in successful teaching and learning of common fraction concepts (Tchoshanov 2010:144). Holmes (2009:352) confirm that the teacher with adequate PCK in common fractions can consider learners' prior knowledge of and structure his/her lesson in a manner that will accommodate different learners. According to Felder (1996:20), Felder (2010:2) using different learning styles during teaching and learning of common

fractions accommodate diverse learners; as a result, teaching and learning of common fractions becomes successful. In addition, the work of Rosenshine (2012:38) reveals that by using different teaching styles, the teacher individualises the teaching of common fractions and different learners would be accommodated.

According to Fuchs, et al., (1997:175) by so doing, the teacher is responding to different learner challenges and help each learner to make sense of common fractions concept. Shulman (1986:3); Moyer, Bolyard, and Spikell (2002:272), indicated that PCK gave the teachers knowledge to select the most useful forms of representation of ideas about common fraction concepts. This assists the teachers to choose the most powerful analogies, illustrations, examples, explanations and demonstrations. In addition, it helps the teacher to select and use an appropriate teaching style that suits different learner' learning styles (Dunn, & Dunn 1993:3; Willingham 2005).

2.4.4 Possible threats for the formulation of the framework

The preceding section discussed conducive conditions in detail. This section address the threats that might prevent the framework of the teaching and learning of common fractions using a context-based approach to work successfully as expected.

2.4.4.1 Risks factors that threaten teaching and learning of common fractions

Time constraints have been identified as one of the threats that can hinder the development of the strategy to enhance the teaching and learning of common fraction concepts using a context based approach. Various factors contribute to time limitations during the teaching and learning of common fractions. Some of these factors are the need for the teachers to finish the syllabus on time as a result the teachers are compelled to rush through these concepts. Other factors can be the degree of complexity of these concepts, which require more time.

According to the methodological bricoleur, to penetrate the complexity of common fraction concepts, a fluid and eclectic approach is needed, and it requires time (Rogers 2012:4; Kincheloe 2005:335). DBE, diagnostic test (2014:175) share the same view that, since common fraction concepts are at a higher cognitive level, more time is required to teach these concepts. Ndalichako, (2013:69) argue that time limitations during the teaching and learning of complex concepts like common fractions result in the memorisation of rules and procedures that are involved in the teaching and learning of common fraction concepts

without a deeper understanding of these concepts. To alleviate this problem of time constraints, the teacher needs to secure more time for the understanding of these complex concepts. This can be done by requesting permission from the relevant stakeholders to teach learners on weekends or after school.

2.4.4.2 Risks factors in the teaching and learning of common fractions

There are risk factors that are involved in the teaching and learning of common fraction concepts. These factors involve learners' pre-knowledge, the teachers' approach, and the complexity of the concepts. These factors can pose a threat to the learners' understanding of common fraction concepts. Learners' pre-knowledge can pose a threat to their understanding of common fraction concepts. According to (Ndalichako 2013:69), learners' pre-knowledge form a background to the understanding of common fraction concepts. It is therefore important that the teacher should build the understanding of these concepts on their pre-knowledge.

However, teachers' approach to the teaching and learning of common fractions can be a risk in teaching these concepts. Mitigating these risks can assist in developing fraction sense in learners (Kor, Teoh, Mohamed, & Singh 2018:169). Fraction sense is a collection of fundamental perceptions and conceptions about fractions rather than a single common fraction idea (Rogers 2012:2; Kor, Teoh, Mohamed, & Singh 2018:169). According to Way, (2011:54); Johanning, (2011:99) fraction sense is learning experiences that allow exploration and experimentation with fractions. Alluding to this, Way, (2011:154) posit that fraction sense build learners' conceptual understanding of fractions, and help to develop appropriate strategies in common fractions task rather than associated with procedural understanding.

2.4.4.3 Risk factors that threatens teaching and learning modalities.

There are risk factors that are involved in using modalities in the teaching and learning of common fraction concepts (Pashler *et al.* 2008:105; Dunn 1990:225). These factors include the way modalities are used to teach these concepts and the time constraints that are involved in using them. These factors can be the barrier in the learners' understanding of common fraction concepts. The success of using teaching and learning modalities depend on the way the teacher is using them to teach these concepts (Barnett 2016:34). Therefore, the success in developing learners' conceptual understanding of these concepts depend upon the teachers' ability to connect and transfer meaning between different representations of the same ideas (Kincheloe 2011:690). More often, teachers use traditional lecture methods

to teach common fraction concepts. This method has the potential to marginalise learners and accommodate only auditory learners (Dörnyei, Skehan 2003:594; & Rogers 2012:11). This approach has proven to be ineffective because it deprives the learner a chance of developing a deeper understanding of common fraction concepts (Ni, & Zhou 2005:27). The teachers need to use teaching and learning modalities in a way that connects and transfers meaning between different common fractions representations (Rau 2017:720).

Furthermore, teaching and learning modalities help to represent common fractions ideas in multiple ways (Suh *et al.* 2005:2). These modalities include real context, manipulatives, pictures, verbalisations and symbols. According to methodological bricolage, a combination of multiple practices help the learners to explore different contexts, representations and task types (Rogers 2012:5; Kincheloe 2005:335; Tobin. 2018:33). For example, naming common fractions and locating common fractions on a number line, folding paper strips and string and other related tasks (Chen & Fu 2003:350).

Actually, models of teaching usually have a strong influence on sustaining the framework of using a context-based approach to teach common fractions. Overall, these models suggest how the planning, implementation, and evaluation of lessons should be done (Nielsen, & Abildgaard 2013:280). With models, teachers can learn to consider appropriate characteristics of teaching; however, these models do insufficient justice to the reality and complexity of teaching and learning common fractions practice (Beijaard 1995:290).

According to Mendiburo (2010:1) this is due to the teacher's lack of knowledge about the effective use of modalities. Arguing this Wexler and Luethi-Garreht (2015:18) posit that teachers more often accommodate auditory learners and neglect, other learners, with different learning styles. Teachers often do this by using chalk and talk method to impart the knowledge to the learners (Sekwena 2014:3). This approach benefits auditory learners more than other learners do. The teacher can mitigate this situation by using different teaching methods that accommodate different types of learners.

2.4.4.4 Factors that threatens relevant PCK in the context-based strategy of teaching and learning of common fraction.

The lack of sufficient teacher's pedagogical content knowledge can be one of the threats in developing the envisaged context-based strategy that will enhance the teaching and learning of common fractions. According to National Academies Press (2001:428) the teacher who has inadequate PCK in common fractions lacks the subject matter and pedagogical

knowledge that will help the teacher to identify learner's misconceptions. This was prominent if learners are required to work with the division of common fraction concepts. According to Ward and Thomas (2006:128) deficiency of PCK in common fraction, concepts make it difficult for the teacher to offer an explanation that can help the learners to develop fraction sense (Desta 2019:101). This forces the teacher to resort to algorithmic or a rule-based approach to the teaching and learning of common fractions. Bricolage indicates that the teacher with an inadequate PCK, lacks multiple teaching methods that can help to diversify the teaching and learning of common fraction concepts (Mahlomaholo 2014:176; Kinchloe 2005:328); Naghavi 2015:10). Alluding to this notion Olanoff, Lo, and Tobias, (2014:298); Depaepe *et al.*, (2015:85) posit that, this makes it difficult for the learners to develop the deep understanding of common fraction concepts. One of the causes of the deficiency in teacher's PCK can be improper staffing (Ali & Botha 2006:345). This happens when the teachers given mathematics to teach while they have specialised in other subjects. Ali and Botha, (2006:345) confirm that inadequate PCK makes it difficult for learners to develop a deep understanding of common fraction concepts by the learners.

2.4.5 Evidence to enhance teaching and learning of common fraction.

This section is concerned with the indicators of success, which indicate the achievement of the context-based framework of enhancing the teaching and learning of common fractions.

2.4.5.1 *Common fractions become understandable to learners*

The aim of this study was to design the framework of the teaching and learning of common fractions in grade seven using a context-based approach. The study intended to respond to the problems of the teaching and learning of common fraction concepts. The framework gives learners an opportunity to develop fraction sense and make these concepts understandable to learners (Woodward 1998:1; Way 2011:154; Johanning 2011:99; Fennell, & Karp 2017:648:99;). The study also attempts to design a framework that can enhance the teaching and learning of common fraction concepts by transforming approaches that the teacher uses to teach these concepts. In designing the framework, I agree with Way (2011:154) and Suh *et al.* (2005:2) who argue that an approach used by the teachers to teach common fraction concepts, should be in such a way that common fraction concepts become meaningful to learners. According to Moyer, and Mailley, (2004:244), the context-based approach assists learners in clearing up the misconceptions of understanding common fractions. This helps to

develop a deeper understanding of common fraction concepts in learners (Rosenshine (2012:38).

Furthermore, to make it understandable to the learners, the framework suggests a bricolage approach where the teacher use learner’s pre-conceptions as a tool, to enhance their understanding of common fraction concepts (Wyatt 2014:170). Agreeing to this, (Pantziara and Philippou, (2012:61) and Marks, (1990:5) argue that conceptions help to build learners’ understanding of common fraction concepts. Another good aspect of the framework is that it helps in linking learner’s pre-knowledge with the knowledge of common fraction concepts (Lamon 2020:73). Alluding to this Caswell, (2007:15) posit that, using examples drawn from learners’ context and daily experience help to enhance common fraction concepts knowledge. Adding to this notion, Fazio and Siegler, (2011:12), Wu (1999:15) and Ward, and Thomas (2007:130) reveal that this helps to foster a deeper conceptual understanding of common fractions. This can help to deepen learner’s conceptual and procedural understanding of common fractions (Shin & Bryant 2015:3). For instance, a recipe requires $\frac{1}{4}$ kg of sugar for one cake. How many cakes could be made with $1\frac{3}{4}$ kg of sugar? Then learners can use a different method to show understanding, e.g. $1\frac{3}{4} \div \frac{1}{4}$

$$\frac{7}{4} \times \frac{4}{1}$$

$$\frac{28}{4}$$

7 cakes

From the context, you can teach common fractions better. By asking yourself the following questions, how many quarters are in one whole? This is demonstrated in Figure 2.15 below.

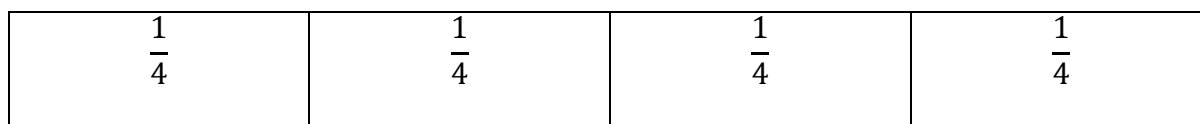


Figure 2.15: Demonstration of whole to find the number of quarters.

Where $\frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{4} = \frac{4}{4} = 1$

Secondly, the teacher also try to demonstrate how many quarters can you get from a $\frac{3}{4}$ by using fig 2.16 below.



Figure 2.16 : Demonstration of quarters

$$\frac{3}{4}$$

Where $\frac{1}{4} + \frac{1}{4} + \frac{1}{4} = \frac{3}{4}$

Therefore, after adding 4 quarters and 3 quarters, then the answer is 7 quarters which is equal to 7 cakes (.This approach links common fraction concepts to learners' context, which is believed to have a potential of developing a deeper understanding of these concepts (Molebale 2005:54; & Chamane 2016:20).

Pursuing this further Shin and Bryant (2015:3) aver that, this helps to deepen learner's conceptual and procedural understanding of common fractions.

Alternatively, the teacher can ask learners to show $\frac{1}{4}$ in 3 different shapes to avoid limiting construction where the learners might assume that a quarter is only found in one shape ,e.g. in a square object. See Figure 2.17 below

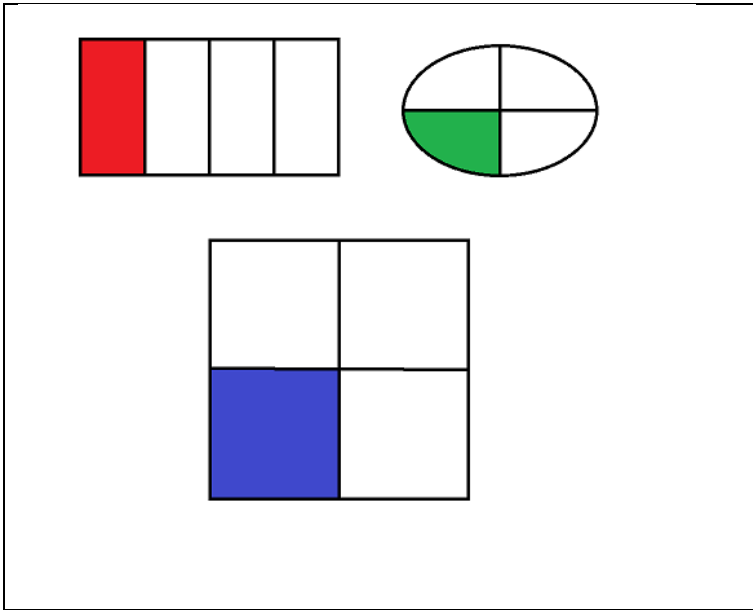


Figure 2.17: Presenting 3 different types of a quarter

$$\frac{1}{4}$$

2.4.5.2 Concretion approach to teaching and learning of common fractions.

Another aspect of the framework emphasises the concretion approach to the teaching and learning of common fraction concepts. As Rosli, Goldsby, and Capraro (2015:1718) suggested, through concretisation of common fraction concepts, the framework hopes to contextualise the teaching and learning of these concepts, and link it to the learners' daily experience. This assisted learners in making sense of these concepts. As Mdluli (2013:3) and Marchionda, (2006:91) argued, the framework seeks to achieve this through practical demonstration to open a self-discovery procedure by allowing a more learner-centred approach. This allows the learners to be actively involved in teaching and learning of common fraction concepts. In pursuance of this Caswell, (2007:15) argue that learners' knowledge with real-life experiences and tasks constructed plays a vital role in learners' learning of common fraction concepts. To demonstrate this, the teacher distributed papers to each learner in an attempt to contextualise teaching and learning of common fraction concepts, as shown in 2.18 below.

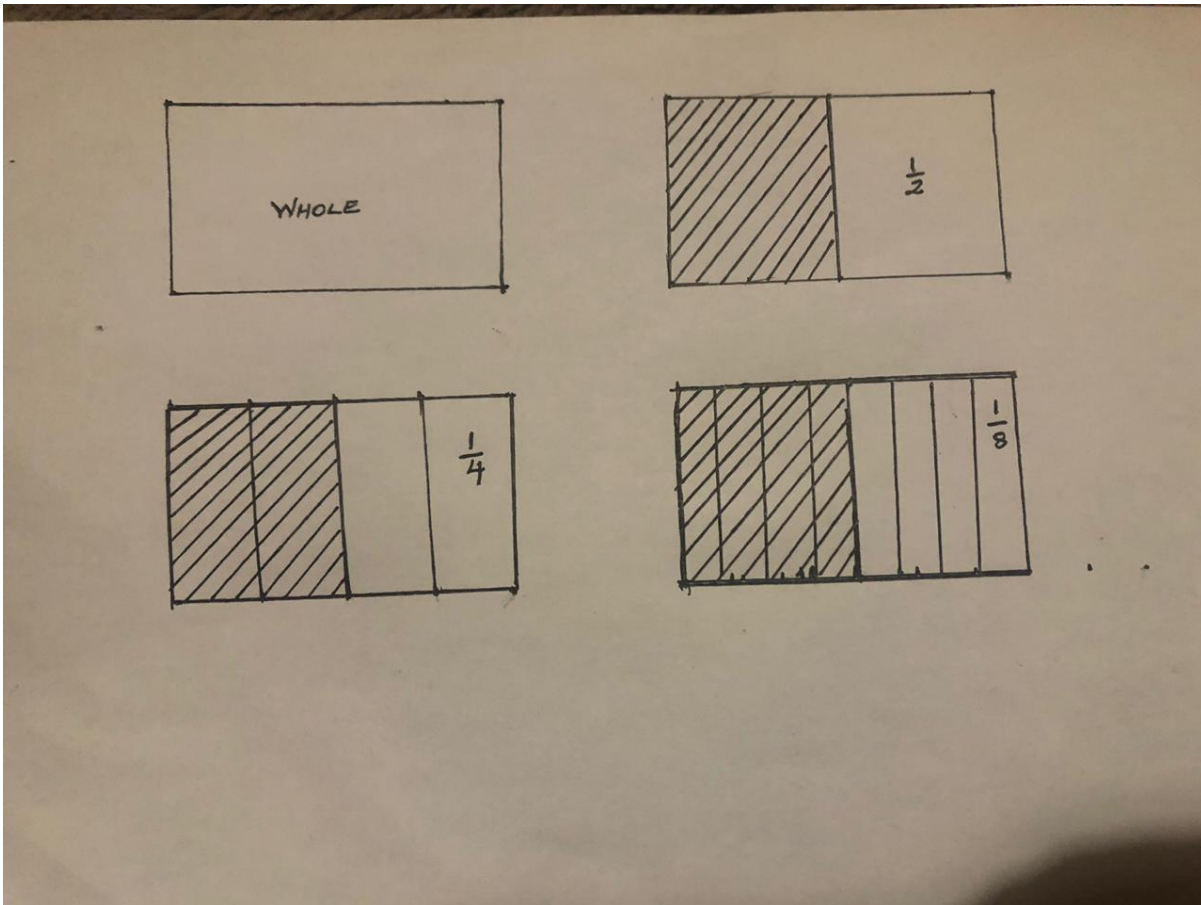


Figure 2.18 : Demonstration of paper folding of whole

$$\frac{1}{2}, \frac{1}{4} \text{ and } \frac{1}{8}$$

In the context above the teacher uses real objects such as paper folding to enhance learners' understanding of equivalent fractions. Learners should be able to construct their understanding of unit wholes and part of whole concepts when folding a piece of paper. As learners fold the paper into two or more parts, they should be able to recognise the relationship between equivalent fractions.

The shaded parts show $\frac{1}{2}$, $\frac{1}{4}$ and $\frac{1}{8}$ respectively of one unit whole. The concept shows the relationship between the representations as learners fold the papers. Once learners fold the paper vertically for the second time, they should see that the paper divided into four equal parts and the same shaded area is equivalent to $\frac{2}{4}$. As the folding process carries on, teachers assist learners in construction of equivalent fractions, $\frac{1}{2} = \frac{2}{4} = \frac{4}{8}$. Thereafter the teachers can also give the addition of common fractions to the learners as follows: The

teacher then gave learners the following sums to do using the approach above. For instance. Bongwiwe needs $\frac{1}{4}$ material for the table in her dining room and $\frac{3}{8}$ material for the curtain. How much material will she need? $\frac{1}{4} + \frac{3}{8} = \frac{5}{8}$, where $\frac{1}{4} = \frac{2}{8}$

$$\frac{2}{8} + \frac{3}{8} = \frac{5}{8}$$

Apart from this, the teacher can also use a concrete object to get the solution for that particular problem. For example, as depicted in Figure 2.19.

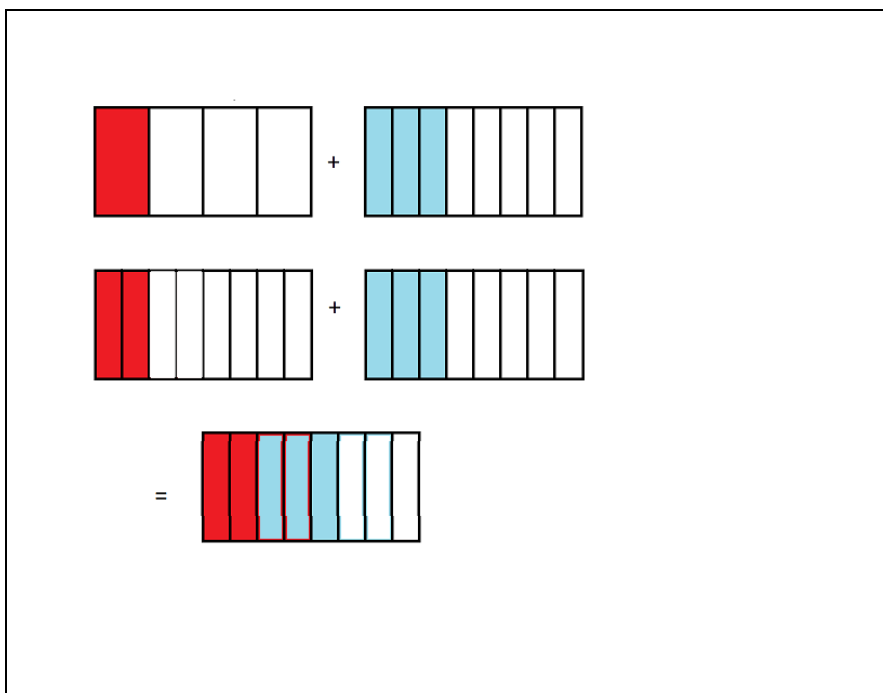


Figure 2.19: Demonstration of addition of mixed fractions

$$\frac{1}{4} + \frac{3}{8}$$

In mathematics classrooms, teachers use concrete representations to support learners discovering and developing abstract concepts. Moreover, learners are engaged in problem-solving as they manipulate objects as they search for a solution. They also can enhance their deep knowledge when posing a scenario problem that matches to the appropriate manipulatives. Based on Suh *et al.* (2005:54) concrete objects are the source of learning because learners learn better by doing.

2.4.5.3 *Teachers possess adequate pedagogical content knowledge in the teaching and learning of common fractions.*

This framework addresses the issue of developing teachers' Pedagogical Content Knowledge to help them deal with the problems related to common fraction concepts. This is important because common fraction concepts are complex and challenging to both teachers and learners (Fazio & Siegler 2011:1; Stiqomah, & Prabawanto 2019:152). Tirosh, (2000:6) avers that the teacher must have adequate PCK in these concepts to discover the misconceptions that can hinder learners' understanding of these concepts. I agree with Sibuyi (2012:9) who argue that the knowledge of learners' conceptions assists the teacher in tailoring the teaching strategy that can mitigate this problem. The framework further attempt to help the teacher to transform common fractions knowledge into various forms that enable learners from the different learning environment to understand these concepts (Lemov 2010:147). As Ma (2010:882) indicated, the envisaged framework attempts to empower teachers with PCK that enables them to be capable of stimulating learner's curiosity and enhance self-esteem in common fraction concepts.

Ma (2010:882) confirmed this, postulating that teachers with adequate pedagogical content knowledge are capable of stimulating learner's curiosity and enhance self-esteem during teaching and learning of common fractions. In addition, Tirosh (2000:6) reveal that PCK is necessary for the teacher to identify learner's misconceptions in common fractions and correct where necessary (Tirosh 2000:6).

2.4.5.4 *Using modalities to enhance the teaching of common fractions*

Another good aspect of the framework is the use of teaching and learning modalities to teach common fraction concepts. As revealed in the work of Mahlomaholo, (2014:176; Kinchloe, (2005:328); Naghavi, (2015:10); Ainsworth (2006:184); and Awla *et al.* (2014:242) that, teaching and learning modalities play a significant role in accommodating learners' diversity. Through the implementation of this framework teachers are empowered to use the teaching and learning modalities in a way that accommodate different ways in which learners make sense of common fraction concepts (Bale 2006:55; Druken, & Marzocchi, 2019:56). Awla *et al.* (2014:242) suggested the use of models like paper folding, Cuisenaire rods, online virtual manipulatives and other teaching and learning modalities that can assist in deepening learners' understanding of these concepts. (Pashler *et al.* 2008:105; Dunn 1990:225; Awla, Hawkar & Akram 2014:241) share the same view that, the more variety we can offer in the

way we deliver information, the more effective we will be teaching and learning of these concepts.

Alluding to this Awla, Hawkar and Akram (2014:241) posited that, teachers need to use a variety of models so that flexibility and fluidity amongst different models is supported. In addition (Awla *et al.* 2014:242; Rosli, Goldsby & Capraro 2015:1718) posit that, using different types of method like rules and procedures, number line and manipulatives with those created by the learners as most significant, and are beneficial to allow learners to construct these concepts on their own. The following example was used: Grade 7 learners in a Technology class make a small bus from $\frac{1}{4}$ of a metre of wire. How many busses can they made from 4 metres of wire?

Arguing these further learners can use a variety of methods to find the number of buses. For the first method, they use circles, where (o) represented a $\frac{1}{4}$ metre, which is equal to 1 bus. Secondly, they represented by using a number line, and they use one metre of wire and measure $\frac{1}{4}$ apart, by doing that learners manage to calculate the total number of buses which add up to 16. Lastly, they use rules and procedures, and there were able to find the total number of buses equal to 16. Therefore, these learners manage to penetrate the complexity of common fractions, which concurs with bricolage as my theoretical framework (Rogers 2012:1; Mahlomaholo, 2014).

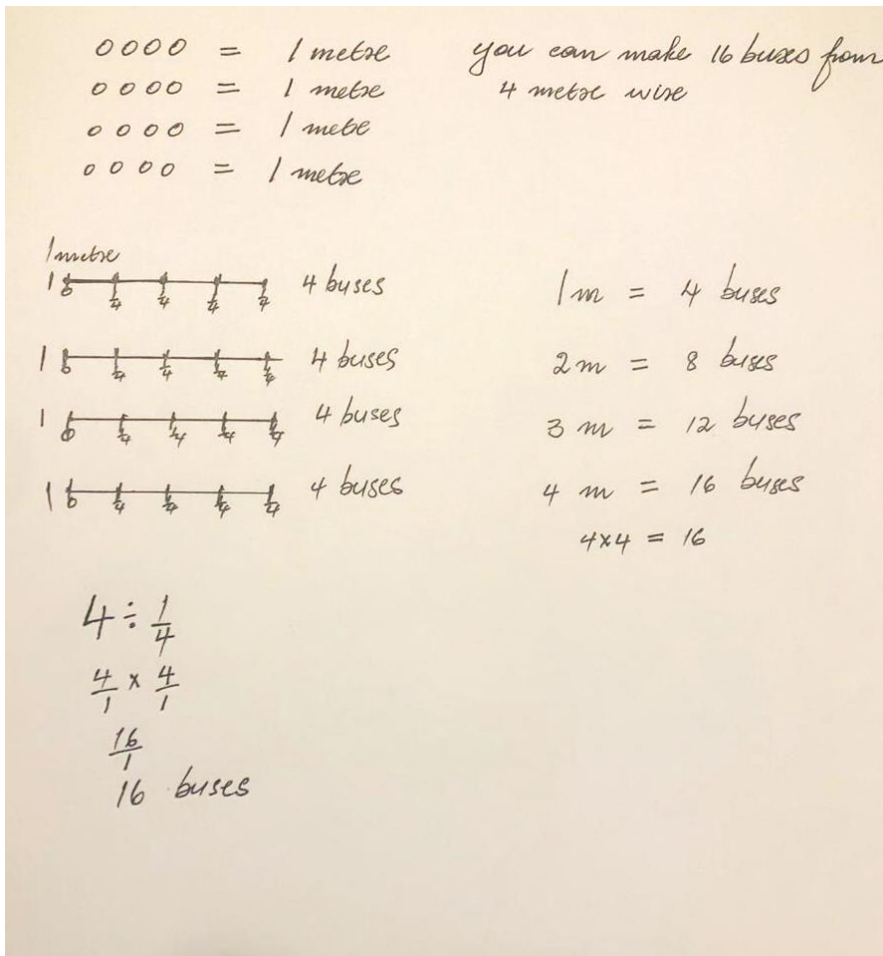


Figure 2.20: Demonstration of a bus wire

$(\frac{1}{4})$ from 4 metre wire.

Furthermore, the teacher can use the following example. During land, re-distribution $\frac{3}{4}$ of the land returned to the landowners to be divided into $\frac{1}{8}$ per landowner. How many landowners can be able to get that particular land?

Learners can use fraction strips to discover fraction size, which is the tool at hand (Rosli, Goldsby & Capraro 2015:1718) and the relationships between the fourth and the eighth. From this figure, learners should be able to recognise the relationship between models and make connections to their prior knowledge about fractional numbers. On the other hand, learners can notice the underlying relationship, six sets of $\frac{1}{8}$ in $\frac{3}{4}$. This is also confirmed by bricolage that prior knowledge is the tool that learners have (Kincheloe 2005:337).

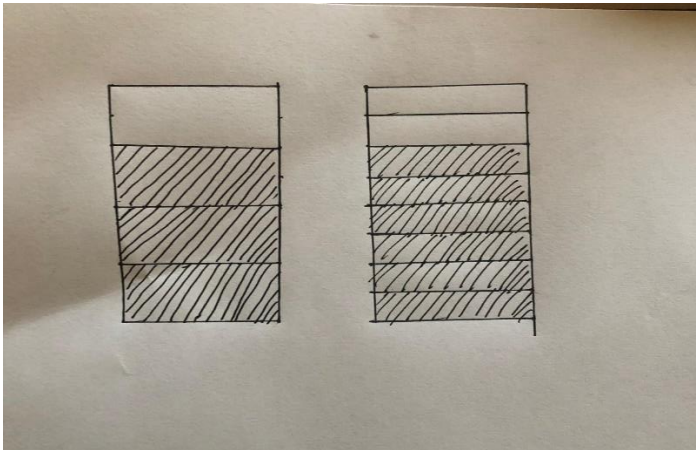


Figure 2.): Presentation of fractions

First diagram represents $\frac{3}{4}$ and the second diagram represents $\frac{6}{8}$.

Learners will notice that there is a relationship between these two diagrams. Meaning that $\frac{3}{4} = \frac{6}{8}$ and there are six sets of $\frac{1}{8}$ in $\frac{3}{4}$ (Rosli, Goldsby & Capraro 2015:1718). Furthermore, rules and procedure can be used as follows,

$$\frac{3}{4} \div \frac{1}{8}$$

$$\frac{3}{4} \times \frac{8}{1}$$

$$\frac{24}{4}$$

$$6$$

2.5 SUMMARY OF THE CHAPTER

This chapter discussed bricolage as a theoretical framework, the historical origin of bricolage using eight historical moments and the formats of bricolage that fit in the study. Epistemology and ontology is also discussed, in trying to understand how learners come to learn common fraction concepts. On the other hand, the researcher is trying to understand how the learner's context play a role in understanding common fraction concepts. The study further outlined the objectives of bricolage, the role of the researcher and the relationship between the

researcher and the co- researcher. Furthermore definitions of operational concepts are also highlighted. Lastly, the chapter presents a literature review on how other countries, internationally, continentally and regionally, involve learners using context-based strategies to improve the learning of common fractions. Best practices are copied from the mentioned countries to support in developing the recommended strategy in South Africa.

3 CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

The study aims to utilise the participatory action research (PAR) methodology of generating data to design a strategy for the teaching and learning of common fractions in Grade 7 using a context-based approach. In conceptualising fractions, I focus on PAR'S origins, definition and importance in generating data. The chapter also discusses the operationalisation of PAR by giving the description of the research area, profiling the co-searchers and describing the stages of data collection. The chapter also highlights CDA as a technique utilised for data analysis. This strategy is discussed in the context of three levels: textual, social and discursive paradigms.

3.2 APPROPRIATENESS OF PAR

PAR is a process of mutual learning where researchers are co-learners and work in collaboration with their co-researchers throughout the research process (Mc Taggart 2006:169). PAR assist both teachers and learners in working collaboratively and helping learners to re-discover their strength in solving mathematics problems. Therefore, I found PAR to be appropriate for this study. Furthermore, PAR allowed me to use diverse methods to identify and describe problems on the teaching and learning of common fractions (Lewin, 1946:36; MacDonald 2012:35). By doing so, we cannot simply neglect numbers and quantities. Learning about fractions encompasses becoming aware of unusual relations between numbers and quantities and learning to express these relations in diverse ways. During the teaching and learning of common fractions, a common problem identified lends itself to an iterative approach, namely, the adding of fractions with different denominators. Therefore, the teacher can use learners' scores to find progress and work from there. For example, $\frac{1}{2} + \frac{1}{3} = \frac{2}{5}$ if there is no improvement, he can start afresh up until there is progress. This iterative process is well suited to the iterative character of PAR.

the discussion below includes PAR's origins and relevance to the study.

3.2.1 Historical origin of Participatory Action Research

PAR's origin can be traced back to the work of Kurt Lewin of 1944, who is considered to be the founder of action research (Baloyi-Mothibeli 2018:67; Dube 2016:101; Gillis & Jackson 2002:264; Glassman & Erdem 2014:4; Mokotjo 2017:67). Lewin predicted iterative cycles of

problem-definition, fact-finding, goal setting, action, and evaluation to simultaneously resolve problems and produce new knowledge (Lewin, 1946:38).

Work guided by MacDonald (2012:12) states that PAR used to address challenges facing the marginalised in the community to find solutions to their problems. I also note that this approach will assist all stakeholders within the DoE, such as learners, teachers and DoE. For instance, fractions are problematic to learners all over the country (Brown & Quinn 2007:8, Siegler & Fazio 2011:6). This means that the problem has already been identified and now teachers are working collaboratively to assist learners in solving common fraction challenges. This also agrees with the theoretical framework of this study. For example, talk about collaboration, multifaceted, and various theoretical perspectives in the study meshes with the discussions in PAR (Dube 2016: 100; Wicks, Reason & Bradbury 2008:3). Lewin further encourages learners' involvement in decision making in the operationalisation of their workplace. This is appropriate as PAR has developed mechanisms whereby the working-class people can be taken into consideration in decision making involving them (Baker & Nelson, 2005:340). This means that learners are motivated to share their experiences with other learners if given a chance to do so during teaching and learning of common fractions.

I found PAR to be appropriate to the study, as it matches many aspects of bricolage, which is also critical, multi-perspectival, multi-theoretical, multi-methodological and socially interactive (Rogers 2012:2). These perspectives allow different teaching methods to be in place using whatever material is at hand, e.g. apples, papers, objects, pizzas cakes and representations in the teaching of fractions, to design a strategy to improve the teaching and learning of common fractions in Grade 7 using a context-based strategy.

PAR can also be traced back to the work of Paulo Freire; a Brazilian inspired by PAR through, critical consciousness and empowerment (Vacarino *et al.* 2006:19). Critical consciousness and empowerment allow conscientisation meaning self-awareness and self-belief, which was innovative theory at the time (Yamaguchi 2000:33). He paid more attention to transforming people's lives by using education as a means of change (MacDonald 2012:34; Ozanne & Saatcioglu 2008:425; Yamaguchi 2000:3). It was, therefore, necessary to teach them how to use these rights, i.e., through education, there was a need to teach them how to fulfil their duties as citizens. He encourages learners that through education, they can change their lives completely. Briefly, practice and life experiences of the co-researchers were considered to improve the strategy of teaching and learning in Grade 7 using a context-based approach.

3.2.2 The objectives of PAR

According to Ozanne and Saatcioglu (2008:425) the key objectives of PAR is to improve the social wellbeing and use devices of replication and action as well as being emancipatory. PAR helps co-researchers to develop new abilities and is empowering, thus, it is influenced by transformation (Kemmis & McTaggart 2000:285).

3.2.2.1 *PAR involves various stakeholders in research*

PAR permits all stakeholders, especially those whose lives are affected by the problem under scrutiny, to participate in the research (Armstrong 2003:3). Furthermore, PAR plays an important role in accommodating all learners in the class, even those learners that are experiencing challenges during the addition of fractions. PAR empowers co-researchers and researchers to learn from involvement and move in the direction of a better understanding of abstract matters (Armstrong 2003:3). This allows PAR to report on broader issues involving the inclusion, social justice and empowerment of oppressed society (Eruera 2010:1; Molebetsi 2016:90). According to Ozanne and Saatcioglu, (2008:425), PAR is a methodology for research in communities that put prominence on participation and action. It pursues understanding the world by trying to change it, collaboratively and following reflection. PAR highlights co-operative inquiry and investigation grounded in experience and social history (Burgess 2008:430). It is a way of life that is grounded in principles of democracy, equal opportunities and education as individual tools in the direction of change (Koch & Kralik 2006:2). PAR practitioners believe that through collaboration with different team members we can come up with solutions and make a difference (Koch & Kralik 2006:2). In conclusion, I agree with Reason (2006: 147), that participation is a dogmatic authoritative because it emphasises the important human right of individuals to contribute to resolutions that touch them. This results in a good relationship during teaching and learning of common fractions.

3.2.2.2 *PAR is democratic*

Another important consideration of PAR is that it is democratic because PAR is reflected autonomous, reasonable, emancipating and life-enhancing, which differentiates PAR from other qualitative methodologies. This is due to the parts played by the researcher and the co-researchers (MacDonald 2012:34). Thus during teaching and learning of common fractions, teachers allow the involvement of all learners to share their ideas, even shy learners are accommodated. MacDonald (2012:34) further revealed that it is a way of life grounded in principles of democracy, equal opportunities, and education as individual tools in the direction

of change which remains different from other qualitative methodologies, particularly concerning the roles played by the researcher and the co-researchers.

3.2.2.3 *PAR solves social and learning problems*

PAR, as a methodology for research, solves social and learning problems and uses diverse methods to report problems or opportunities recognised by a community (Armstrong 2003: 3). PAR is relevant for this study because it challenges power imbalances. It allows the perceived powerless to control their lives or to strengthen their voices (Hall 1993: xvii). Learners with challenges are empowered by teachers who use different approaches in solving problems, in particular common fractions. By doing that, all learners are actively involved and free to express their views by sharing ideas both with learners and teachers. PAR, according to Koch and Kralik (2006:2), allows the enrichment of repetition and the construction of information in community groups and it produces new ways of working, interacting, and knowing to solve social and learning problems.

3.2.3 *Formats of PAR*

The formats of PAR are about the development of the society to which the co-researchers relate intending to bring social change. Social change can be attained through networking with a variety of people. The following paragraphs outline three formats of PAR.

3.2.3.1 *PAR as a social process*

PAR as a social process, emphasises that no “individuation is possible without socialisation, and no socialisation is possible without individuation” (Habermas 1992b:26). Therefore, it is necessary for learners to work collaboratively to develop an effective strategy to improve teaching and learning of common fractions in Grade 7 using a context-based approach.

PAR, as anticipated from a societal practice position, par is said to promote “intentionally the relationship between the realms of the individual and the social” (Kemmis & McTaggart 2007:280). On the other hand, PAR procedure is theoretically permitting, redeeming, and consciousness-raising for individuals, as it delivers a critical understanding and reproduction of social issues (Kemmis & McTaggart 2007:280). PAR also serves as “social change, democratic forms of interaction and decision-making leading to empowering and democratic culminations to help the powerless and imperative” (Selener 1997:237). The co-researchers are energetically involved in all phases of research. Community members are perceived as individuals with authority, unlike in the olden days, where the researcher occupied the most

important position during the research process (Eruera 2010:1). Moreover, the PAR project stimulated people to additionally develop informally conscious, critical, creative and confrontational as teacher-researchers (Esau 2013:1). Hence the educator and learners are not just anxious with altering and cultivating their repetition in the classroom, but also with shifting unsatisfactory relations in the broader social setting (Esau 2013:3).

Relating this to fraction problems, PAR allows the teaching and learning of fractions to be a social activity in which learners are involved in discussion, discovery, clarification, cooperation, explanation, sharing, reproducing and evaluating of fractions in mathematics. It is, therefore, necessary that teachers use this method for understanding learners as self-determining thinkers who can construct their own knowledge in a social atmosphere of reflection and sense-making of the fractions tasks. Learners ought to be motivated to apply their own familiar information to solve common fractions and participate. Throughout collaboration and participation, all community members must be involved in solving difficulties and advancing a sound notion of fractions over a time during which each learner's learning method is appreciated and treasured during the teaching and learning of fractions.

3.2.3.2 *Self-efficacy*

PAR as self-efficacy allows co-researchers to discover and comprehend their situation for them to act to change it to their assistance. Self-efficacy for the study refers to the confidence of teachers and learners in their ability to perform their roles in teaching and learning of fractions (Saito 2009:5). By being involved in PAR, as indicated by Watters, Foley, Bryan, Berna Prehn and Stallings (2011:1090), one has a chance to share thoughts and positions on some issues and participate in decision-making which would result in experiencing personal empowerment. Personal empowerment would lead to the development of increased feelings of confidence, self-efficacy and self-esteem. Eruera (2010:5) contends that the researcher and the co-researchers should adopt the positions of being co-investigators who collectively engage in and convert the investigation process. Moreover, PAR's outcomes are both about facts generation and direct action, which gives stakeholders authority to direct the research process, address real contextual needs, encourage teamwork and collaborate (Mubuuke 2013:34).

PAR is a research approach that seeks to associate participation and action. According to Gaffney (2008: 10), participatory means that there is no difference between the researchers and the researched, unlike what often happens in other research approaches. Participation

is a multi-faceted term that includes a collection of different practices inspired by competing philosophical assumptions (Cassell & Johnson 2008:795). In addition, PAR as participation allows the interaction of people so that the research is not done on people but with them, in solving real-life problem (JuuJarvi & Lund 2016:1; Mokotjo 2017:71). In this way, participants become co-researchers and representatives of change through active involvement during the research process (MacDonald 2012:42).

3.2.3.3 *PAR as a critical perception*

The critical perceptions of PAR in this study acknowledge that all stakeholders need to have a deep conceptualisation of fractions and the relationship with their world and embrace working collaboratively and relating to others (Kemmis & McTaggart 2007:282). PAR can assist learners in improving, and free themselves from the limitations, implanted in the shared media through which they cooperate—their language (discourses), their types of labour, and the social associations of power in which they engage themselves in connection and variance inclusion (Samuel 2014:79). Therefore, in this way PAR resolves all the challenges of teaching and learning of fractions from a critical process perspective. These utterances confirm that PAR is an approach that permits an improvement in social practice by converting challenges and ensuring learning from the consequences of those acts. Therefore, PAR is a process of using critical views to appraise action and developing it.

Clark (2010:120) further contends that epistemology is about sharing knowledge to address power differences among the co-researchers. During this process, they allow all stakeholders to voice out their opinions to establish trusting relationships (Howell & Annan Singh 2013:35). Therefore, during the teaching and learning of fractions, all stakeholders involved would be given a chance to share their ideas about fractions. This can allow learners to be able to discover things for themselves and become critical thinkers. Articulation by Maton and Moore (2010:2) denotes that knowledge is the base of education as a societal field of preparation. It is the production, contextualisation, teaching and learning of knowledge that makes education a distinct field.

3.2.4 Ontological stance of PAR

Ontology in PAR emphasises social reality, where reality is viewed by a social group (Majola 2018:56). It is, therefore, necessary that learners should have the same views about common fraction concepts. This can happen in their context. For example, two learners share three pancakes amongst themselves (Tobias 2005:126). This can be done by using fair sharing

amongst the learners. Learners can also learn that in a real-life situation, they must have Ubuntu. Hence, Nussbaum (2003:2) views Ubuntu as a consciousness of our natural aspiration to encourage our fellow learners to work collaboratively with one another. Furthermore, Ubuntu acknowledges, among other things, that, my wealth is your wealth, meaning that learners share what they have, which is the nature of reality (Lutz 2009:315).

3.2.5 Epistemology of PAR

Epistemology in PAR is the co-construction of knowledge; whereby all members of the team are allowed to take an active part in the creation of knowledge (Baloyi-Mothibeli 2018:75; Martens 2009:4; Mash 2013:1; Mokotjo 2017:75; Rogers 2012:3). This creates a conducive and democratic condition that would maximise the co-researchers participation without any fear and discomfort (Majola 2018:55), creating an element of trust and close relationship where the team members will work collaboratively (Spekman & Carraway 2006:10). In the teaching and learning of common fractions, this can be achieved by using group work. Koch and Kralik (2009:3) confirm that group work allows learners to work in collaboration, participate actively, and contribute towards the co-creation of knowledge about common fraction concepts. Tobias (2005:125) posits that this allowed the learners to participate fully by sharing their experiences without being scorned by others.

This allows learners to compare their pre-knowledge to the new knowledge of common fraction concepts (Turşucu, Spandaw, & De Vries 2020:1). This allows the learners to change or transform their preconceptions about an acceptable common fraction concept. This means that conceptual change would have occurred in learner's mind.

3.2.6 Axiology of PAR

Axiology is described as the nature of ethics (Mertens 2015:10), that has cultural admiration that encourages social justice and human rights; addresses inequities; interchanges and recognises strengths (Dube & Hlalele 2018:78; Mthethwa 2017:45).

According to the literature, axiology studies the elements that can contribute to the intrinsic value of a state of affairs. These include:

- Improving social justice and human rights;
- Respecting cultural groups;
- Challenging discrimination and oppression;
- Relationships based on trust;
- Recognising strengths and resiliency;

- Addressing power inequities; and
- Providing reciprocity, sustainability, and honesty. (Mertens 2015:14).

Researchers viewed democratic participation, in “radical democracy”, as an important means of self-development and producing individuals who are more tolerant of difference, sensitive to reciprocity, better able to engage in moral discourse and judgment, and more self-reflective. (Mezerow 20013; Warren 1995)

3.2.7 The role of the researcher

The role of the researcher is to monitor the co-researchers to take charge of their thinking, attitudes and actions (Wood, Morar & Moster 2008:28). Changes on an intellectual, emotional and social level are more likely to be constant as they become part of the personal and professional identity of the co-researchers (Batagiannis 2011:84; Wood 2012:2). During teaching and learning of fractions, the teacher monitors the progress of learners. The teacher uses learners’ misconceptions to correct them; by doing this, learners develop a positive attitude towards fractions and gain more self-esteem. The character of the scholar in this background is reframed to distinguish inequalities and injustices in society and struggles to challenge the status quo. These are the action of a provocateur with implications.

3.2.8 The relationship between the researcher and co-researchers

The researcher and the researched can gain or create knowledge through interactions and negotiations (Edwards & Holland 2013:17). During the discussion of team members about fractions, all members of the team can benefit from one another by gaining a deep understanding of common fractions. This is evidence that the researcher does not treat co-researchers as objects of research, but provides a space for growth (Baum 2006: 854; McTaggart 1997: 9;).

The above connotation confirms that PAR continues to convey collective action and reflection, theory and practice, by encouraging participation of different individuals, in pursuit of practical solutions to issues of pressing concern to people, and more generally, to promote flourishing of persons. Furthermore, Walker (1990:61) has drawn attention to the fact that emancipatory action research certifies “teachers’ voices and those of their learners as allies in the research initiative to be heard as producers of instructive information”.

Learners and teachers are called co-researchers because they participated equally and democratically (Miller & Rose 2008:102). This qualified them to be at the centre of the

research project. They further took an active part in finding solutions to the teaching and learning of common fraction concepts. Since the teachers and learners as the people with challenges in common fraction concepts were in the best position to understand, describe and report their challenges. They were the people who experienced those challenges during the teaching and learning of common fractions in the classroom situation. Thus, they ended up with embarking on research to change the teaching and learning of common fractions, to enhance learners conceptual understanding of common fractions.

3.2.9 Rhetoric / language

The language used in PAR act as a mechanism to empower, improve or further marginalise the oppressed (Baum 2006: 854). Also, PAR encourages people to work collaboratively and be the ones who can act as agents of change and improvement and recognises each member of a team.

Solutions in PAR are found through negotiation amongst community members (Madelon 2016:1). PAR could be used to eradicate inequality and change people's lives. During the teaching and learning of fractions, learners would be allowed to contribute. This practice could ensure that as co-researchers, we learn from our mistakes and successes. We will also avoid the mistakes and emulate the successes of others. To manage the PAR process, the following steps were followed: Putting the team of co-researchers together, having an information session, developing the mission and vision for the research team, doing a SWOT analysis, setting priorities, drawing up a strategic plan and action plan for observation and implementation.

3.3 PAR PROCESS

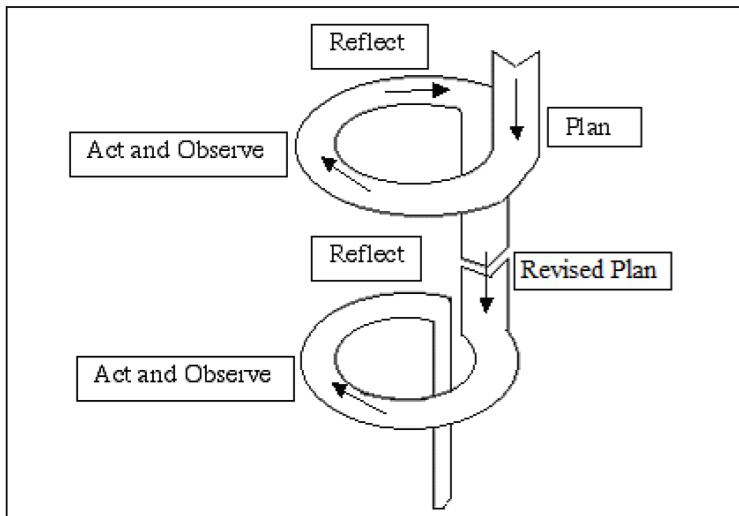


Figure 3.1: PAR spiral cycle

3.3.1 The steps involved

Different steps were involved in the implementation of PAR. The problem appeared in the centre of the conversation. The first step included preparation, where the study coordinator, together with the team, was involved in the process of conceptualisation. I started by selling the idea to all co-researchers using, listening, discussions and reading of the literature. This was followed by the second step involving planning. Plans were formulated according to what should emerge during monthly meetings. The third steps involved implementation and feedback that the team provided consciously together with challenges they came across. The fourth step was the reflection stage, where the plan was monitored collectively as a team. At that stage, the aims and objectives, the implementation steps, plan and methodology used by the team, were considered. PAR was used as the methodology because it allowed active participation of all the team members. Data was collected by using a voice recorder. CDA was also used for textual, discursive and social structural analysis (Van Dijk 2009:50). The team also conducted a SWOT (Strength, Weakness, Opportunities, and Threats) analysis. The planning phase

During the planning phase, the ethical clearance was considered, and permission to conduct research at Amajuba district was requested and obtained by the study coordinator.

The focus group planned the way forward; that is, they agreed on actions to be executed in teaching and learning of common fractions by using a context-based approach. This

demonstrated that the focus group possessed the action plan and the abilities to execute it. Khupe and Keane (2017: 26) declared that research needs to be developed in such a way that it aligns with co-researchers' lived contribution, indicating the requirements for the community members to be identified for the team. Furthermore, Denzin (2010:307) describes that if the overloaded, downgraded and silenced groups take control of their own lives and humanity, then the project of liberation can become a reality. We can work together towards the construction of decolonised and transformed learning environments. This can be achieved through respectful, transformative and decolonising research that informs teaching and learning of fractions as well as community engagement practices. Chilisa (2012:12) emphasises that the community action proposal should display the impartiality of the research project, the goals to be achieved, plans to achieve the objectives, the timeframe, persons accountable, possessions required, and monitoring and evaluation

3.3.2 Ethical Considerations

Research principles are the ideologies and guidelines that control how people should be treated as contributors in a research process or project. The Free State Ethics Committee firstly granted permission for the title registration. Approval was subsequently granted by the DBE in KwaZulu-Natal to conduct research in the selected school. During formal and informal meetings with the principal to discuss access for the research study at the school, the population and type of research to be conducted was clarified. Moreover, a letter from the DBE giving the go-ahead for the study was tabled and discussed with all the co-researchers.

Furthermore, the co-researchers were requested to sign consent forms to be part of the study, and they agreed to do so. During the official and informal meetings, all co-researchers were told about the moral considerations involved in the study. This included that the study was planned to be implemented in a manner that would not cause harm or threaten the lives of the co-researchers. Signed completed consent forms were also obtained from the learners' parents.

The co-researchers were also made aware of their right to remove themselves from the research project any time they wished. Their anonymity was assured for all the partakers. This is in line with sentiment, stating that the researcher had an ethical responsibility towards the co-researchers concerning the information given (Neuman 2006:397). It was also explained that for the research pseudonyms would be used for co-researchers and the school

selected for the research. The usage of audio and videotape was discussed and agreed upon, as was who should get to see the information gathered.

3.3.3 Permission to access school

I received permission to access the selected school. Signed consent letters were obtained from the co-researchers while the Department of Education also granted permission for the study to be conducted.

3.3.4 The first meeting

The first meeting did the planning for change to begin. I held a conversation with the Grade 7 learners and all stakeholders identified. I started by introducing myself and elucidated the aim and objective of the study. A venue for a meeting was set, and the dates for the meetings was agreed upon. The team members agreed to meet every Wednesday 15:30. A total number of 12 meetings were held and 6 class observations and different mathematics teachers were observed. During the discussion, the challenges faced by the teachers during teaching and learning of common fractions in Grade 7 were discussed.

This meeting was very fruitful because even the learners' views were shared among the group. The main reason for the meeting was formally asking all stakeholders and learners to work hand in hand with me as a co-researcher with an attempt to alter our teaching and learning of common fractions for Grade 7 learners and further introduce Participatory Action Research for use in the study. Hence, PAR assist both teachers and learners to work collaborate and help learners to re-discover their strength in solving mathematics problems.

3.3.4.1 *Putting the team together*

During the Grade 7 phase meeting, it emerged that mathematics teachers should work together as a group in the same school so that we could get to know our learners and share ideas to improve the poor performance on common fractions. The teachers also proposed that we incorporate different stakeholders that were in the school to determine what was happening in the teaching of common fractions. They further suggested that we should also involve the learners in a group to encourage learners to cooperate vigorously during the teaching and learning of common fractions and invite an expert to share ideas with the group.

Then I chose to convene a meeting with the groups and also invite Grade 7 learners, consisting of one class, to establish a participatory partnership for collectively addressing the

issues identified. This meeting was very fruitful, as even the learners' views were shared among the group.

The main reason of the consultation was to properly request all stakeholders, including the learners, to work hand in hand with me as a co-researcher as an attempt to improve our teaching and learning of common fractions for Grade 7 learners. I also further introduced participatory action research for use in the study.

The team met on the date that set for the meeting. The team members were composed of one Grade 7 class with thirty-five learners and seven teachers. All team members were present during our first meeting. Consent forms were given to the adult co-researchers, and assent forms were handed out for parents or guardians, giving learners permission to participate in the study. Letters were also sent to the schools where some of the researchers were employed asking permission for the school and learners to participate in the study.

3.3.4.2 *Credentials of the co-researchers*

(i) Study Coordinator

The researcher started teaching in Cooper Combined primary school in 1993. I taught mathematics in the GET, senior phase, Grade 7, until I was promoted as a head of department (HOD) in 2002. I continued teaching mathematics as HOD in Cooper primary school. In 2007, I was transferred to Silindokuhle Primary School, where I continued with teaching mathematics in Grade 7. The motive behind embarking on this research was the poor performance I observed on learners in mathematics, especially in common fractions concepts. In observed this poor performance at my old school and at Silindokuhle Primary school. I decided to take common fractions as my title because I felt that learners were struggling with common fractions. I was trying to assist learners in coming up with solutions since the learners are the ones with the solutions to their problems

(ii) Principal

The principal of Silindokuhle Primary School, who was teaching grade seven Mathematics for 20 years before she became a principal. She has ten years' experience as a teacher, five years as a head of department and five years as a deputy principal. She is supportive, dedicated to her work. She is highly qualified with the following qualifications Senior Primary Teachers Diploma (SPTD), specializing in Maths and Science, Higher Education Diploma (HED), also specializing in Maths and Science, BED (Honor's) degree in educational management and she is busy with master's degree at the moment with the following title:

Empowering teachers and learners with word sums in grade six. The major reason for selecting her to be part of the study is her expertise and experience in mathematics. She manages, guide, develop and support all educators at school and monitor extra classes for mathematics. Her input in the study plays an important role since they work hand in hand towards challenges faced by mathematics educators. The principal was selected following her expertise and contributions in assisting Grade7.

(iii) Deputy Principal

The Deputy Principal was a post level 3 teacher at Silindokuhle primary school. She held Primary Teacher's Diploma (PTD) specialising in mathematics and physical science, and she was busy with an Advanced Certificate in Education, specialising in management. She assisted the principal in managing the school.

(iv) HOD

The Head of Department (HOD) for mathematics has been teaching mathematics for Grade 4 to 6 from 1999 to date. She has 20 years of teaching experience. She has seven years' experience as a teacher, 13 years as a Head of Department. She holds Senior Primary Teacher's Diploma (SPTD) specialising in mathematics and physical science, a Higher Education Diploma, and she recently received her Honor's Degree in Education Management. She knows the challenges that learners have in mathematics, as she is the one who is responsible for monitoring the curriculum. She also assists learners who are struggling with mathematics during the weekend. It is for this reason that I chose her as one of the coresearchers.

(v) Mathematics teachers

The mathematics teachers started teaching the subject in this school twenty years ago. The male mathematics teacher had appropriate qualifications and taught mathematics in Grade 7 for twenty years. He used to conduct extra classes on holidays and weekends, to revisit aspects covered during the year. At the time of research, he was still teaching mathematics in Grade 7 class. The female mathematics teacher mentioned that she was pleased to be part of this group, as she believed that the framework would benefit the teaching and learning of fractions. All seven teachers were concerned about the performance of learners in mathematics, especially in common fractions. The involvement of these teachers was crucial as they had experience in teaching fractions. From the discussion with the team members, it emerged that many mathematical concepts are embedded in learners' daily-life activities.

These involve activities like sharing, measuring ingredients ready to be cooked, partitioning that would promote interest among learners and encouraged them to engage in higher-order activities. In addition, these two teachers could present the content of fractions by using different available methods and strategies, conducting instructions and to evaluating what learners are learning.

(vi) Learners

There were 35 grade seven learners involved in the research team. Their ages ranged from 12-16 years old. These learners had attended this school from Grade 5 up to grade 7. Therefore, this was their third year at this school. The teacher-learner ratio was 50: 1 and most learners were from poor economic backgrounds and impoverished families.

I started by brainstorming everything with them and telling them more about PAR, making learners free to voice out whatever knowledge they had. After the discussion, learners were actively involved in the discussions and assumed that the use of context-based teaching would allow the classroom environment, which was too formal and threatening at times, to accommodate their home circumstances. Furthermore, this continuation of home education into the school programme revealed that learners in Grade 7 were experiencing difficulties with fractions and their class teacher observed this when they failed to divide one whole into three equal parts. Therefore, this study aimed to find a strategy of instilling the foundational knowledge of fractions for learners to have a deep conceptual understanding of fractions.

(vii) School Governing Body

The coordinating team involved two parents; both were retired mathematics teachers, who used to assist learners who were experiencing challenges in mathematics from grade five to seven. They were teaching mathematics while they were still serving with the Department of Education at the nearby school. The first SGB member has thirty years of teaching experience, and the second one has thirty-five years of teaching experience. They believed that the school must be characterised by respect, tolerance, learners who were willing to learn, democracy and motivation. Their role as parents was to instil the love of mathematics in learners because parental care and contribution was the most important feature in effective teaching and learning. Furthermore, parental support is a tactic satisfying a physical pledge and leveraging the psychological relationship between a parent and a learner. PAR, through parental involvement, bridges a gap between the researchers and the proposed receivers of the research benefits (Turnbull *et al.* 1998:178).

(viii) Subject advisor

The subject advisor was an education specialist (mathematics and natural sciences), who held a Senior Teachers Diploma, a Higher Diploma in Education, a degree in mathematics and a master's degree in curriculum studies. He was an expert in mathematics, especially in the senior phase. He is responsible for supervising and supporting senior phase mathematics teachers in the implementation of the curriculum and all other features required for effective teaching and learning in mathematics.

3.3.5 Session 2

3.3.5.1 *Information session*

During this session, the purpose of the research was outlined regarding the roles and responsibilities of each member of the team, particularly the co-researchers. This is in line with what is captured by Mash (2014:3), who postulated that the group needed to decide on how they would create the inquest, which often includes developing original plans for varying practices grounded on co-researchers' prior involvement and additional information. This session captured the strategies of inviting more members and encouragement amongst members. Moreover, the meeting dates, agenda, topics and responsibilities of members were discussed. Tagum (2013:5) maintains that a generous process promotes good relationships, teamwork and collaboration amongst the co-researchers. Time frames were also highlighted as a crucial aspect. The team agreed on creating the mission and vision for the team.

3.3.5.2 *Developing the mission and vision statement of the team*

The created mission and vision statements are used as a source of reference to guide the team in formulating the strategic plan that would guarantee that matters associated with the vision were not disregarded. The setting of the timeframe was also a crucial facet in the plan, as it kept team members focused and vigilant. They ought to discern when the assignment would be completed and the scope of the planned activities. This permits the allocation of required resources in time to accomplish the activities.

It is important for the strategic plan to be known by all; therefore, the developed plan should be circulated amongst members, especially those who were not part of the development planning stage, for endorsement or amendments if required. This practice demonstrates respect for the value of the contributions of other people. A detailed action plan and realistic

timetable are essential for the attainment of the desired goal. Through this exercise, the team was empowered, and the plan was supported. This declared ownership as a condition for the dissemination of information about the programme, its benefits and accomplishments (Wawrzynski LoConte & Straker 2011:17). The circulation of the plan amongst the team members and all stakeholders was to remind them of the contracts agreed to and the persons accountable for detailed activities. The next paragraphs highlight the vital phases in the Strategic Plan that includes SWOT analysis, setting priorities and research design.

3.3.5.3 *Working out the policy of the team*

In this section, the research design is defined to display how the study was planned and structured to obtain the data. Further, the formulate the team and its strengths, weaknesses, opportunities and threats are discussed, as well as the sequence that was planned and how the PAR meetings were handled.

3.3.5.4 *SWOT*

The team utilised a SWOT analysis to weigh the strengths, weaknesses, opportunities and threats and guide our activities in terms of our objectives of solving our research problem using knowledge, the skills and resources that were gathered during discussions with the co-researchers (Hickling-Hudson 2006:100). The SWOT analysis developed awareness among the team members to work collaboratively in dealing with the problem of the teaching and learning of common fraction concepts in Grade 7. The SWOT analysis drove the researcher and co-researchers to understand and match their strengths to opportunities and try to eliminate threats while they attempted to overcome weaknesses.

(i) Strengths

The team consisted of the team members with multiple and diverse strengths which emerged from the knowledge, experiences and expertise that they possessed, which greatly enriched the study. Mathematics teachers had majored in mathematics, and they had a deeper understanding of mathematics concepts, especially common fractions. They used to conduct extra classes every holiday, to revisit different aspects covered during the year and those sections that were difficult during the teaching and learning of common fractions. They also took into consideration the different types of learners that were in the class, by using different learning styles, keeping in mind that all learners were not the same. The SGB members' strength was to bring their experience and expertise to group discussions. Permission for using the school was granted by the principal. All the resources for the discussion meeting

were in place, and included writing materials. Strengths are positive outcomes towards teaching and learning of common fractions.

(ii) Weaknesses

Weaknesses are inside issues that are unfavourable for attaining the goals of a particular organisation. Time was a weakness because more time was needed while the co-researchers had other commitments over the weekend. There was no funding involved to cover expenses during the research. The other challenge that we encountered was that some researchers were not always participating in meetings due to other commitments. Some learners were using transport.

(iii) Opportunities

The coordinator and team members had an opportunity to contribute directly to finding the solution for the teaching and learning of common fractions, which is considered as one of the most challenging subjects in the community. The teachers and the learners had an opportunity to work together with the common goal of developing the strategy that could enhance the teaching and learning of common fractions in Grade 7 to solve challenging work and common fraction concepts. During this process, learners had an opportunity to voice their concerns about the challenges that they came across during the teaching and learning of common fraction concepts. Co-researchers could be empowered by being given a chance to research their own lives and generate knowledge that would lead to the solution of their problems.

(iv) Threats

One of the threats that emerged during the research process was the issue of power that exists between the teachers and learners. The African culture emphasises respect for an elderly person and the everyday teacher-learner relationship was based on respect where teachers were always considered as superior and having power over the learners that was based on their content knowledge. The limited time available for the research was also a challenge because some co-researchers were staying far and they had the problem of transport. Another threat was the lack of funding as some were travelling for long distance to get to their homes.

3.3.6 Session 3: Setting priorities and developing strategic planning

At this point, as the team, we set priorities as required by the strategic plan. The co-researchers were actively involved in the research project. The co-researchers had developed a sense of ownership towards the research project.

3.3.7 Research site profile

The school was situated in the Province of KwaZulu-Natal. The school consisted of 17 teachers and 508 learners, of which 308 were boys and 200 girls. The learners were divided according to their grades, and the staff by a distinction between teachers and non-teaching staff members. The staff consisted of a team of two mathematics educators, 30 learners, two parents (SGB members), three school management team members (Principal, Deputy Principal and mathematics HOD) and a mathematics subject advisor.

3.3.8 Session 4

3.3.8.1 *The generation of data*

The data was generated during discussions, meetings and observation sessions scheduled with co-researchers. After that, the data was coded according to the themes of this research in accordance with the strategy to advance the teaching and learning of fractions. This was done through the reading of transcripts numerous times to familiarise ourselves with the data and to note preliminary concepts and themes and through categorising related parts which matched with each code (Manjoko 2013:159). The data that was collaboratively generated with co-researchers permitted designing of the strategy to improve teaching and learning of fractions for Grade 7 learners. Bricolage, as the theoretical framework, underpinned the study supporting the view that an individual has the ability and vigour to be creative in response to challenging settings.

3.3.8.2 *Instrumentation methods and techniques employed in generating data*

The use of instruments for capturing data during the research is a sensitive matter; thus a principled protocol is required, and permission must be obtained from co-researchers in the discourse of the deliberation in the respective discussions.

A voice recorder was utilised to record the discussions during meetings, workshops and focus group meetings to design the strategy to improve the teaching and learning of common fractions. The voice recordings were necessary for analysis and permission was obtained to record the proceedings of the discussions. The Free Attitude Interview (FAI) technique was

used. This practice permitted members to be involved in free discussions relating to how to expand the execution of teaching and learning of common fractions in Grade 7. The auditory recordings came in handy to later listen to all discussions with co-researchers, the direct quotations, the comments during discussions, reactions and the feelings of all members. The benefit of the voice recording was that of permitting the reiteration and evaluation of the logged contents of the negotiations for dictation and scrutiny without being reliant on memory.

3.3.9 Data analysis

CDA was used in this study for data analysis. CDA predominantly studies the manner the exploitation of societal authority, domination and inequality are endorsed, repeated and resisted by text and talk in the social and political setting (Van Dijk, in Wodak 2013:1). According to Bergold and Thomas (2012:23), CDA examines concerns that have to do with any system of manipulation, power relations and inequality, which might be entrenched in the text or spoken language. CDA was deemed suitable for this study as it permitted me to uncover the political agenda, the dominion behind the text, the insertion of certain communications against the prohibiting of others, and the mode(s), in which particular morals were articulated and realised (Kiersey & Hayes 2010:332).

3.3.9.1 *Historical Origins of CDA*

CDA as a notion grew from Foucault's (1969) concepts of discourse, and was extended further with Halliday's concept of Systemic Functional Linguistics (SFL) (Halliday, 1978:1994). Fairclough (2001:229) postulates that CDA is used as a device in studies of official scripts to explore how language figures "as a component in community procedures". Tenorio (2011:184) postulates that contributions of the greatest persuasive European academics' presentations intended to raise responsiveness about performances used in emerging, preserving and repeating supremacy through language usage. Therefore, CDA research functions from the view that language figures and is moulded by societal practices (Fairclough 1995:89), and has been cited by many experts as an operative technique of doing social policy research; with apparent attention on language shared with an assignation with social theoretical issues (Fairclough 2001).

CDA was utilised because of its capacity to detect occurrences of discursive prejudice in transcript and talks and denotes a form of opposition to immoral and undeserved social supremacy relations amongst co-researchers. Therefore, CDA takes a detailed cognisance in the relationship between language, power and social formations. The last but equally

influential school of thought on CDA is that of Van Leeuwen, which holds that people in a society are influenced by policies and decisions of powerful organisations through inclusion or exclusion from the centres of power (Rahimi & Riasati 2011:109).

3.3.9.2 *Nature and scope of CDA*

CDA inspires the use of language and power that is suitable to all stakeholders involved in designing the strategy to improve teaching and learning of fractions despite their different levels in the community (Wodak 2013:2). Rahimi and Riasati (2011:109) maintained that CDA would allow the researcher to organise incidences of conversational prejudice as a form of fighting the unprincipled and unfair social control relations, which are founded in human actualities as acquainted by inadequate general structures. For me using CDA permitted taking of an explicit position, to understand, expose and eventually fight social inequality. This practice was critical for the strategy to improve teaching and learning of fractions to be feasible.

Moreover, CDA empowered co-researchers to have a better knowledge of the conducts in which language was utilised, which not only replicates socio-cultural observations but also provides for their construction and modernisation. Therefore, the use of a concrete concept for fractions could be scrutinised and the reaction of co-researchers observed through CDA. According to Khumalo (2018:149), CDA empowers the identification and analysis of feasible extents of dimness and divergence amongst the three stages of analysis meant for each of the intended research objectives. Additionally, CDA requires language usage that at times has the ethnic inference to encourage a certain correspondence, which was crucial in designing the strategy to improve teaching and learning of fractions using concrete objects that aggravates the routine of control and authority in human relations (van Dijk 2008:353).

3.3.9.3 *Levels of CDA analysis*

The application of CDA is done at three levels, which are as follows: firstly, a textual analysis which denotes text spoken or written; secondly, a discursive operation referring to interpretations of discourse practices; and production, consumption and reproduction of text. Lastly, discursive social practices which relate to the interpretation and description of text. Myende (2014:23) indicate the importance of these levels, in explaining how and why social practices are constituted, changed and transformed.

(i) Textual analysis used in this study

Textual analysis is executed with the intent to disclose organisational inequities portrayed by co-researchers in their engagement with the programme (Khumalo 2018:153). Bloor and Bloor (2013:6) mention that text has to do with acceptability in relations of suitability to the traditional setting and how text is received by co-researchers. This aims to expose how far the point of information communicated is more or less suitable for the receivers in the situations. Analysing in this level according to Khumalo (2018:153) permits articulation of the text creation, circulation and clarification, specifically concerning the system in which the circulation is steered to a “favoured” interpretation. This practice allowed discovering of tactics in which societal transformation was reinforced through the participation of diverse contributors.

(ii) Discursive practice analysis

According to Scharff (2008:333), analysis at this level helps in finding a social directive through conversational collaboration, which approves scrutiny of the dialectal language of co-researchers. Analysing discourse necessitates sustaining and reproducing of the social standing in the manner that contributes to transformation, increasing vital issues of control. Shozi (2018:76) highlighted that discourse means figurative human contact in its many forms, whether unswervingly through spoken or written language or visual representation. During this phase, we would be able to discover with what range the conceptual view of the co-researchers moulded and predisposed consultations (Carvalho 2008:169). This illustrates that the investigation is useful to regulate how the articulated words of the co-researchers’ hypotheses reproduce and maintain understanding in society (Khumalo 2018:154).

(iii) Sociological analysis

Analysing at this level would create knowledge on how social adaptabilities, such as uniqueness, background, age and gender acted themselves out as community settings that prejudiced negotiations about improving the teaching and learning of fractions in the Grade 7 class. Gee (2011: 89) contends that the analysis at this level stands in connection with dependable predominant settings, which necessitates the way resources are functional within social surroundings. Furthermore, Breeze (in Shozi 2018:77) maintain that the social level in CDA comprises of modification in social practices and in the interacting of social practices, how social practices are expressed together in the constitution of social arenas, institutes and associations, and in the relations amongst fields, societies and groups.

3.4 SUMMARY OF THE CHAPTER

This chapter presented PAR as a methodological approach used to generate data with co-researchers with different and diverse understandings. The credentials of the team, the SWOT analysis, the priorities according to the objectives of the study, the action plan and the priorities of the study were also outlined. The section further uncovered how CDA was applied to explore facts from the manuscripts, conversations and social background levels to allow the study to accomplish its intentions as it centres on the standpoints of individuals who are the sufferers of manipulation of authority, supremacy and equivalence.

4 CHAPTER FOUR: DATA ANALYSIS, PRESENTATION AND INTERPRETATION OF RESULTS

4.1 INTRODUCTION

The study aims to design the strategy for the teaching and learning of common fractions in Grade 7 by using a context-based approach. The analysis validates how the five objectives have been operationalised. The objectives look into the challenges as evidence to justify the need for the construction of the strategy. Therefore the chapter will consider the solutions for the identified challenges, followed by the conducive conditions and the threats that may hinder the application of the strategy in the teaching and learning of common fractions.

We will then consider the evidence that is for and against the formulated strategy to note recommendations. All challenges were analysed, starting with the expectations in terms of best practices as indicated by the educational policy and the legal requirements. In supporting the argument that a construct is regarded as a challenge, evidence in the form of pictures and drawings was analysed. The data was analysed at three levels, namely text, social, and discursive practices by using critical discourse analysis (CDA) to get the deeper meaning of the data. Bricolage and PAR analysis were also used to strengthen the study.

4.2 CHALLENGES IN THE TEACHING AND LEARNING OF COMMON FRACTIONS IN GRADE SEVEN

Each challenge was considered by affirming the opportunities in terms of the good practices as indicated by the educational policy, research and theory of learning as identified by the focus group. In supporting the argument that a construct is regarded as a challenge, evidence in the form of spoken words and written words was analysed through CDA .

4.2.1 Calculations relating to common fractions

Learners are experiencing difficulties in calculations that involve common fractions (Lamon 2020:2). This makes it difficult for them to have a deeper conceptual understanding of common fraction concepts. The DoE, in the CAPS, confirms that learners must have a deeper conceptual understanding of common fractions (refer to Section 2.4.1.2). Clement and Sarama (2007: 470) and Pashler *et al.* (2009:114) further argue that teachers must use a variety of teaching methods and concrete objects that learners are familiar with from their home environment, to accommodate the different types of learners that are in the class. Because fractions are important in learners' daily lives, they need a deeper conceptual

understanding of numbers that is usually gained from experience with whole numbers (Siegler, Fazio, Bailey, & Zhou 2013:13). On the other hand, constructivism learning theory argues that real understanding is only constructed on learners' previous experience and background knowledge (Ültanir 2012:195).

It was observed at the research site that the teaching and learning of fractions were taught in a deductive way. This limited the opportunity for the learners to discover things for themselves, and it was difficult for learners to understand and relate fractions to their environment. This was evident when learners were asked by their teacher to choose between half of Dolly's mother's salary or a quarter of Dolly's mother's salary.

Mr Brown arrived in the class to do revision, but he started his lesson by posing a question to the class in this fashion:

Mr Brown: *“Class let us say Dolly's mother is earning R1000-00 per month, if you are given an opportunity to choose between $\frac{1}{2}$ of her salary or $\frac{1}{4}$ of her salary, what would you like to have?”*

Qhamukile quickly takes out her scribbler and start to do some calculations.	
Qhamukile's calculations	$1000 \times 2 = 2000$
Qhamukile's calculations	$100 \times 4 = 4000$
Nonkazimulo's calculations	$1000 \times \frac{1}{2} = 2000$
	$1000 \times \frac{1}{4} = 4000$

Figure 4.1: Qhamukile and Nonkazimulo's calculations

Qhamukile: *“I would like to have a $\frac{1}{4}$ of Dolly's mother's salary.”*

Mr Brown *“Why do you like to have a $\frac{1}{4}$ of Dolly’s mother’s salary?”*

Qhamukile: *“Because I would get a bigger portion which is equal to R4000-00 Sir.”*

Mr Brown: *“Let us find another opinion class.”*

Nonkazimulo: *“Confidently) I concur with Qhamukile’s answer Sir $\frac{1}{4}$.”*

Mr Brown: *“What makes you to choose a $\frac{1}{4}$ Nonkazimulo?”*

Nonkazimulo: *“After calculating I noticed that $\frac{1}{4}$ of Dolly’s mother’s salary will give me more money.”*

Mr Brown: *“Do you mean a $\frac{1}{4}$ is bigger than $\frac{1}{2}$?”*

Nonkazimulo: *“Yes Sir.”*

Mr Brown: *“Ok, what is the feeling of the class?.”*

Learners: *“A $\frac{1}{4}$ Sir” [some learners were silent].*

Mr Brown: *“Class let me show how to find the right answer.”*

$\frac{1}{2} \times \frac{1000}{1} = \frac{500}{1} = \text{R}500-00$ $\frac{1}{4} \times \frac{1000}{1} = \frac{250}{1} = \text{R}250-00$

**Figure 4.2: Mr Brown’s calculations.
Demonstrating that R500-00 is bigger than R250-00**

Mr Brown *“Therefore $\frac{1}{2}$ the salary of Dolly’s mother is bigger than a $\frac{1}{4}$ of Dolly’s mother’s salary Do you understand class?”*

Learners: *“Yes Sir.”*

Learners who responded with a $\frac{1}{4}$ were convinced that the answer was correct, while those learners who were silent were not sure about their answer, which is why they remained silent. Nonkazimulo thought that half is a part of a whole, while Qhamukile takes fractions as whole numbers. This was evident in the steps above.

The learners were taught fractions in a deductive manner, which hinders a deep conceptual understanding of common fractions. By conceptual understanding, we mean a deep understanding of fraction concepts and operations (Confrey, King, Stretches, Sutton, Battista, & Boerst 2008:102). This was also evident by Qhamukile and Nonkazimulo's calculations above when their answers were not correct.

Mr Brown did not use concrete objects to concretise his lesson, in such a way that learners can be able to discover that as the denominator becomes bigger the fraction becomes smaller. Mr Brown was supposed to use different presentations and use prior knowledge. Although he tried to familiarise the learners with the environment by using Dolly's mother's salary, Mr Brown excluded some learners in the teaching and learning of fractions. He could rather have used a social grant, or different types of income that the learners know, for instance, grants, pensions etc. to accommodate the different types of learners that were in the class. By doing so, Mr Brown would be able to draw on learner's previous experience and background.

From Qhamukile's responses, it was clear that she did not understand the difference between the fraction and the whole number; hence she multiplied the salary with the denominator and neglected the numerator of a fraction to find the portion of Dolly's mother's salary. This is evident from her calculations that are as follows:

Qhamukile calculations $1000 \times 4 = 4000$

Equation 4-1: Qhamukile's calculations

Nonkazimulo's response shows that she did understand how to express the statement in a numerical form, but failed to multiply correctly. She committed the same mistake as Qhamukile by multiplying with the denominator, neglecting the numerator. This is reflected in her calculation, which was done as follows:

$$\text{Nonkazimulo's calculations } 1000 \times \frac{1}{2} = 2000$$

Equation 4-2: Nonkazimulo's calculation

Look at Mr Brown, the way he phrased his question using Dolly's mother's salary made it easy for the learners to understand the question, because Mr Brown linked the content and the context of learners. He used the inductive approach type of questioning; that is, he moved from the mother's salary (specific situation) to the application of mathematics laws (general rules). I commend the way Mr Brown phrased his question but argue against the way he presented his lesson. When he explained the problem to the learners, Mr Brown concentrated on finding the correct answer rather than showing the learners algorithms that are involved in finding the correct answer. This approach excluded some learners from the teaching and learning process since he did not use different types of teaching instructional method to match his teaching instructions with the learners learning style during teaching and learning of common fractions. This is contrary to bricolage that encourages teachers to use different modes of learning styles to accommodate the diverse nature of learners that are in the class (refer to Section 2.2.2.2). This is also contrary to PAR which encourages collaboration and group work during teaching and learning of common fractions (refer to Section 3.2.3.3). The discursive practice's encouragement of a monological approach was predominant in the first and second moment of qualitative research and contributed to the ontological stance of both the traditional period and the modernity phase (refer to Section 2.2.1.1 and Section 2.2.1.2). This method means that there is only single mode of teaching, which is administered by rules, and only through these rules can we understand how to teach (Kincheloe 2008: 25).

In conclusion, the empirical data collected from the research site concurs with the literature that learners have a problem with the understanding of common fractions which emanate from the preconception that the learners have accumulated from daily experience and some from the approach that the teacher is using when teaching common fractions.

4.2.2 Adding fractions with different denominators

Adding fractions with different denominators has become a difficult issue for both teachers and learners (Brown & Quinn 2006:28). A factor contributing to difficulties in teaching and learning of fractions is the way fractions are presented to the learners. Fractions are presented in an abstract manner that divorces the content and context of the learners.

Ndalichako (2013:69) argue that for fractions to make sense teachers should refrain from devoting too much time in teaching the procedures of the addition of fractions, and less time in teaching a conceptual understanding of fractions. The work of Basturk (2016:35) emphasises the importance of using the multiple meaning of common fractions to enhance the conceptual understanding of adding common fractions with different denominators. DBE (2011:3) further suggests that learners should be taught to identify and solve problems that include the addition of fractions with different denominators to promote critical thinking. Lazića, Abramovich, Mrđaa and Romanoc (2017:751) suggested that various theoretical models should be used for the learning and understanding of fractions to link the theoretical model to different interpretations of fractions to basic operations. Furthermore, Bruce, Chang, Flynn and Yearly (2013:6) encourage teachers to help learners to achieve a solid foundation of adding fractions with different denominators. It is confirmed by the literature (refer to Section 2.7.1) that learners do not understand why common denominators are needed when adding fractions with the different denominators.

Mr Bhandu quickly arrived at the Grade 7 class to teach the addition of fractions with different denominators. Mr Bhandu started his lesson as follows.

Mr Bhandu:

“Good morning Grade 7”.

Learners:

“Good morning Sir”

Mr Bhandu:

“Our lesson today will embark on addition of fractions with different denominators.”

He wrote the following sum on the board. He then explained the rules and procedures of adding common fractions while doing the sums on the board.

1. $\frac{2}{3} + \frac{3}{4}$
 $(4 \times 2) + (3 \times 3)$
 $\frac{8}{12} + \frac{9}{12}$
 $\frac{17}{12}$
 $1 \frac{5}{12}$

2. $\frac{1}{5} + \frac{1}{2}$
 $(2 \times 1) + (5 \times 1)$
 $\frac{2}{10} + \frac{5}{10}$
 $\frac{7}{10}$

Figure 4.3: Calculations of Mr Bhandu.

Mr Bhandu: "Class, who can give me the LCM for $\frac{2}{3}$ and $\frac{3}{4}$?"

The teacher waited a few minutes for learners to respond. None of the learners did so. Mr Bhandu then gave them the correct answer which was 12.

Mr Bhandu: "Are you still with me, If you don't want to talk I proceed"?

Learners: "[few learners responded]: "Yes sir, we are together".

Mr Bhandu quickly finished the sum on the board.

Mr Bhandu: "Now I have shown you how to add common fractions with different denominators."

Mr Bhandu gave learners some classwork to do.

Mr Bhandu: "Add the following fractions. show all your steps." $\frac{2}{3} + \frac{1}{2}$

The following are examples of mistakes made by learners when adding fractions with different denominators.

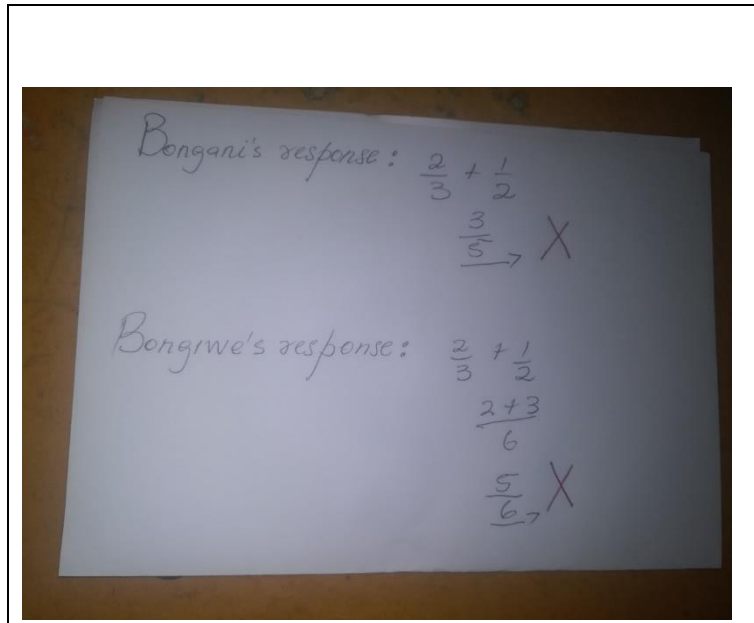


Figure 4.4: Responses of Bongani and Bongiwé

In Figure 4.4, the response from Bongani showed that he had a challenge in adding common fractions with different denominators. This was evident when Bongani was adding numerators and denominators together and got $\frac{3}{5}$. Bongani did not use fractions as part of the whole; he took it as whole numbers because Mr Brown taught fractions in an abstract way. The teacher was supposed to use different methods; he might have used strips, diagrams and representations for the learners to discover the rules for themselves and have encouraged learners to think critically.

By doing so, learners will gain a deep conceptual understanding of fraction concepts, and the teacher will avoid using more time in teaching procedures (refer to Section 2.2.1). As a result, learners find it difficult to use the rules and procedures that are involved in the addition of fractions with different denominators or to apply them appropriately. This teaching approach that is used by Mr Bhandu of following the laws and rules, and neglecting the conceptual understanding of common fractions, is in line with the first moment of bricolage (traditional period) which emphasised rules and procedures. I suggest that the teacher could move away from this old method of teaching and use the second moment of bricolage which encourages learners to derive the rules on their own (Naghavi 2015:8) (refer to Section 2.2.1.2).

The calculation “.... $\frac{2+3}{6}$” shows that Bongiwé succeeded in finding the lowest common denominator (LCM) which is equal to six, but Bongiwé did not manage to use mathematical

operations correctly. Instead of writing $\frac{4+3}{6}$, she wrote $\frac{2+3}{6}$. From this, we can conclude that Bongiwe has memorised some rules, laws and procedures (procedural understanding) involved in the addition of common fractions, but lacked conceptual understanding of common fractions. She was unable to follow the correct rules of adding fractions with different denominators correctly. Since Bongiwe did not understand basic ideas, she might not have an ability to transfer her knowledge into new situations and apply it to a new context. From the mistakes that were committed by two learners, it is clear that the teacher emphasised rules and procedures during teaching and learning of common fractions which is contrary to the best practices above. This is confirmed by Ndalichako (2013:69) who argue that the teacher should spend more time in teaching conceptual understanding of fractions rather than rules and procedures (procedural understanding).

In his presentation, in his comment "*Now I have shown you how to add common fractions,*" the teacher used "*I*" to show that he was the one with the knowledge of adding common fractions with the different denominators, as it was done in the traditional period (first moment)(refer to Section 2.2.1.1). He used his power based on his content knowledge to exclude learners from the process of knowledge creation. This also deprived learners' of the opportunity of working collaboratively and help each other, which was in contrast with PAR principles (refer to Section 3.3). The phrase "*Are you still with me*" shows that learners are passive receivers of information from Mr Bhandu who is the chalk and talk master, which means Mr Bhandu is only talking and writing on the board without involving learners, which is in contrast with bricolage. Even the activities that Mr Bhandu assigned to his learners, where learners were supposed to write their classwork individually, did not promote learner interaction as advocated by bricolage, so that social interaction could create opportunities for learners to talk about their thinking as should have been encouraged (Fraser et al 2004:26).

In conclusion, as illustrated in the literature review, teachers spend more time teaching mathematics rules and procedures than discovering ways of learning (refer to Section 2.2.1.1). Furthermore, the teacher uses a chalk and talk approach when teaching common fractions, and this deprives the learners of an opportunity of working together and discover rules and procedures for themselves. This concurs with the empirical data collected from the research site.

4.2.3 Teaching modalities and learning styles

Modalities and learning styles can affect the teaching and learning of common fractions (Felder & Brent 2005:58). Different scholars have different models (learning styles) about how the learners learn during teaching and learning processes (Awla 2014:241; Kirschner & Merrieboer 2013:170; Naghavi 2015:5; Pashler *et al.* 2008:105). According to Naghavi (2015:5), learning styles refer to the specific ways in which learners engage in learning during teaching and learning of common fractions. Dunn defines the learning style in a different way, in which the learner receives, concentrates, processes, internalises and retains new and difficult information (Dunn 1990:353; Hawk 2007:9). Furthermore, the National Council of Teachers of Mathematics (NCTM) (2000:10) states that learners need a variety of representations to support their understanding of common fraction concepts. In addition, Pashler *et al.* (2008:105) are of the notion that learners learn effectively if they learn in different ways using different types of learning styles, for example, visual, auditory, reading and writing and kinesthetic (VARK) to enhance their learning of common fractions.

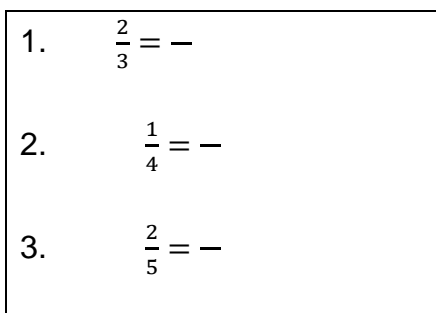
Mr Madonsela was having the first period in Grade 7A. He rushed inside the class and started his lesson, saying:

Mr Madonsela: *“Today class we are going to do equivalent fractions.”*
Without wasting time, let us get into the business of the day.”

Mr Madonsela: *“[Mr Madonsela explained to the class, while writing on the board] Class if you want to find the equivalent fraction you always multiply by one, but in the fraction form.”*

Mr Madonsela explained the procedures while writing on the board

He started as follows:



1. $\frac{2}{3} = \text{--}$

2. $\frac{1}{4} = \text{--}$

3. $\frac{2}{5} = \text{--}$

Figure 4.5: Mr Madonsela's work

After writing and explaining the sum on the board, Mr Madonsela asked:

Mr Madonsela: *“Do you understand class?”*

Busisiwe: *“Mina asangidida ama equivalent fractions Sir [Equivalent fractions are still confusing me Sir]*

Ntokozo: *“Thisha uyibona kanjani ukuthi lena i- equivalent fraction?” (Sir how do you see if it is an equivalent fraction?).”*

Mr Madonsela: *Let me clarify class, in order to get another equivalent fractions we multiply by one but in a fraction form. I think now is clear to everybody.*

Senamile: *“Yes Sir [frowning].”*

Ntokozo: *“Kodwa akungicaceli kahle (ehleba) (But it is not clear to me.) [whispering].”*

Mr Madonsela: *“Senzo, wake up! (Angrily). How are you going to understand when you sleep while I’m teaching? [Other learners in the class burst out with laughter]*

Mr Madonsela wrote classwork on the board as follows:

Mr Madonsela: *“Work out the equivalent fractions from the following common fractions.”*

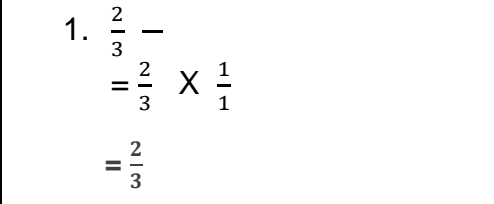

$$\begin{aligned} 1. \quad & \frac{2}{3} = - \\ & = \frac{2}{3} \times \frac{1}{1} \\ & = \frac{2}{3} \end{aligned}$$

Figure 4.6: Mr Madonsela’s classwork.

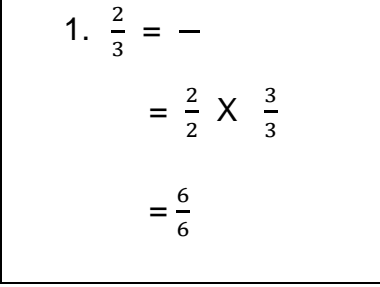

$$\begin{aligned} 1. \quad & \frac{2}{3} = - \\ & = \frac{2}{2} \times \frac{3}{3} \\ & = \frac{6}{6} \end{aligned}$$

Figure 4.7: Busisiwe’s response towards equivalent fractions

$$\begin{aligned} 2. \quad \frac{2}{3} &= - \\ &= \frac{2}{2} \times \frac{3}{3} \\ &= \frac{6}{6} \end{aligned}$$

Figure 4.8: Senamile's response

Mr Madonsela's lesson was teacher-centred with minimal learner involvement. He used the traditional approach that was used during the first moment where the teacher was the sole source of information (refer to Section 2.2.1.1.). This is evident from Figure: 4.3 where Mr Madonsela is doing the sum alone without engaging the learners by using concrete objects, multiple representations and multi approaches. After finishing writing the sum on the board, he then asked the learners if they understood. In his lesson, there is nowhere he attempted to link learners pre-knowledge with the new knowledge. This would have assisted the teacher in identifying misconceptions and alleviating them (Niedderer 2001:406). This is further confirmed by bricolage from Kincheloe (2008:20) who argued that the teacher should include different subjects and indigenous knowledge of the learners as a pre-knowledge to enhance the understanding of the common fractions. From the words uttered by Busisiwe, "*equivalent fractions are still confusing me*" it shows that the method that is used by Mr Madonsela does not accommodate Busisiwe's style of learning. From Busisiwe's utterances, one can conclude that there is no match between Busisiwe's learning style and Mr Madonsela's instructional teaching strategies. Based on the words uttered by Ntokozo, "*how do you see if it is an equivalent fraction?*" one can argue that Ntokozo is a visual learner, who understands better when the teacher is using visual aids. Felder and Silverman (2002:676) attested to the notion that visual learners understand better when they are taught using pictures, drawings, flow charts and demonstrations. Based on what Mr Madonsela is saying, "*let me clarify class,*" you can argue that Mr Madonsela is aware that these learners do not understand equivalent fractions. One can contemplate whether he is aware that he should use different teaching strategies to try and match different learners learning styles to accommodate different types of learners that are in his class. His words, "*class if you want to find the equivalent fractions, you always multiply by one, but in the fraction form,*" is too vague and abstract for the learners. This is reflected when Senamile is frowning, using non-verbal cues that there is a problem.

By frowning Senamile might be showing anger, dissatisfaction or disapproval about the teaching and learning approach that Mr Madonsela is using.

Senamile's responded "Yes" when they were asked whether they understood or not. She was skeptical whether she understood anything from Mr Madonsela's lesson. This might be because of Mr Madonsela's approach to teaching and learning of common fractions. Mr Madonsela is using a single and linear approach in his lesson that marginalises other learners whose learning styles are not matched by his teaching instructions. From the phrase "wake up!" it is clear that most of the learners are losing attention in Mr Madonsela's lesson, as a result, some are sleeping. The reason might be that they find Mr Madonsela's lesson uninteresting. I'm of the view that learners are less interested in Mr Madonsela's lesson because his teaching instructions do not match the learners' learning styles.

Mr Madonsela's approach to teaching and learning of fractions is in contrast with what Pashler *et al.* (2006:105) (refer to section 2.4.3.3) emphasize, which is the importance of using different modes of teaching style during teaching and learning of common fractions to cater for diverse learners with different learning styles. Mr Madonsela's lesson is also not in line with bricolage which emphasises multiplicity in the teaching approach.

The empirical data is in line with the literature that teachers do not use different modes of teaching styles when teaching common fractions that matches their learners learning style. This concurs with the literature (refer to Section 2.4.4.3) that asserted that teachers more often accommodate auditory learners and neglect other learners, with different learning styles.

4.2.4 Pedagogical Content Knowledge

Lack of Pedagogical Content Knowledge (PCK) is one of the challenges in teaching and learning of common fractions. Park and Oliver (2008:264) define PCK as teachers' understanding and representation of how the teacher should go about assisting learners in the understanding of common fractions by varying instructional strategies, representations, and assessments while working within the contextual, cultural and social limitations in the learning environment). Sibuyi (2012:9) further defines PCK as knowledge possessed by the teacher about subject content, teaching strategies and learners' misconceptions. CAPS (DBE 2011:13) emphasises the importance of the teachers PCK in the effective teaching and learning of common fractions.

Miss Zondi is the Grade 7 teacher, she came to the class to present the lesson on division of fractions. She started her lesson as follows:

Miss Zondi: *“Class today I’m going to teach you division of common fractions.”*
Class: *“Yes, Madam.”*
Miss Zondi: *“When dealing with, common fractions you must make sure that you stick to the laws and rules of mathematics.”*
Miss Zondi: *“Are we together class?”*
Class: *“Yes Miss.”*
Miss Zondi: *“Right, let’s take this example.”*

$$\begin{aligned} & \frac{3}{1} \div \frac{1}{3} \\ & = \frac{3}{1} \times \frac{3}{1} \\ & = \frac{9}{1} \\ & = 9 \end{aligned}$$

Figure 4.9: Demonstration of Miss Zondi’s sum
Example of a division sum

[Miss Zondi explaining to the learners]
Miss Zondi: *“You start by coping the sum as it is. Then the rules says change division sign to multiplication sign and invert the common fraction on the right hand side, simplify and get the correct answer.”*
Sindi: *“Sorry Madam, why do you change division sign to multiplication sign?”*
Miss Zondi: *“It is a rule Sindi!”*
Senzo: *“But Madam I don’t understand this rule.”*
Miss Zondi: *“I told you to stick to the rules, we cannot change the rules.”*
Senzo: *“Yes Madam. [scratching his head]”*

Look at Miss Zondi's presentation above; it shows that she was using a teacher-centred approach. In the way she presented the lesson of the division of common fractions to the learners, there was no learner involvement. The words "teach you" indicates that the teacher has the power that is based on his knowledge of the content subject. The words "teach you" is a mind control type of utterance, which subjects learners to the notion that they are empty vessels to be fed with information and the teacher is the only source of information (refer to Section 2.2.1.1). Miss Zondi's words "make sure that you stick to laws and rules" show that she is going to use a monological approach, which is a procedural approach to the teaching and learning of the division of common fractions. From the word "stick" it is clear that the teacher is narrowing learners thinking where the learners should only think about procedures when doing common fraction problems. The use of a monological approach to the teaching of fractions might emerge from the lack of the teacher's PCK; hence the teacher opts for a single, linear, procedural approach, where not much PCK is needed. This is confirmed by the literature where Park and Oliver (2008:264) argue that PCK helps the teacher to understand common fractions by varying instructional strategies, representations and assessments while working, taking into the cognisance textual, cultural, and social limitations of his or environment. The teacher's statement "change the sign into multiplication and invert" is not clear and is abstract to the learners, which indicates that there is a deficiency in the teacher's PCK. This is evident when Sindi asks "why do you change the division sign to multiplication sign?". From the above statement, it is clear that the teacher's explanation of the sum on the board was not clear, and it lacked substantial clarity for the learners. As a result, it impedes the understanding of common fractions. Senzo's utterances also confirm this, "I don't understand this" indicate that these learners did not understand the concept of common fractions. Furthermore, Senzo's action of scratching his head shows dissatisfaction and confusion.

The words "stick to the laws and rules," indicate that the teacher herself has memorised the work she teaches. I assume there is a content gap in the teacher's knowledge of dividing common fractions. This means that the teacher does not have a deeper understanding of dividing common fractions; she has only memorised common fraction laws and rules. The teacher has followed a deterministic, procedural approach to the teaching and learning of common fractions. This emphasises the memorisation of laws and rules as they are in the textbook, and is in line with the traditional moment of bricolage. It was confirmed in

Section 2.4.4.4 that some teachers lacked PCK of common fractions, which meant, they have a challenge in teaching the division of common fractions.

In conclusion, as illustrated in the literature review, some teachers lack PCK, which concurs with the empirical data. The study (refer to Section 2.4.2.1) encourages teachers to have more understanding of dividing common fractions as an important component of an effective teacher's repertoire.

4.3 COMPONENTS OF THE SOLUTION TO FORMULATING A CONTEXT-BASED STRATEGY OF TEACHING AND LEARNING OF FRACTIONS IN GRADE SEVEN.

This study aimed to enhance the teaching and learning of fractions. The solutions are discussed in this section.

In response to the challenges that were identified, the team came up with various solutions to implement. As part of the solutions, the concretisation of the fractions is important.

In Section 4.2, many challenges were identified in the teaching and learning of mathematical word problems, and five were found to be relevant to our theoretical framework. At the same time, components of the solutions were also identified to explore appropriate solutions for those challenges.

4.3.1 Improving understanding of common fractions

The use of demonstrations has been identified as one appropriate component of an active learning framework for teaching common fractions. This component can actively involve the learners in the learning process and so help the learners to remember and apply the abstract common fraction concepts (Darling-Hammond & Bransford 2007:1106). Cooperative learning is aimed at improving learner involvement in the class by placing them in small groups to complete specific tasks given by the teacher (Johnson & Johnson 2009:365). The use of cooperative learning is required by the fact that teachers in South Africa teaching common fractions are encouraged to actively engage learners in their own learning by facilitating learning and by using group work (Sekwena 2014:114). This approach to fractions as a social activity can help learners to be engaged in a problem-solving activity through, explanation, and negotiation, justification, sharing, reflecting and evaluating (Jooster 1999:64). The DoE (2003:2) further asserts that taking advantage of affective domain components, such as values of sharing, developing self-esteem, confidence and caring for oneself and others contribute to learner's performance and the development of problem-solving skills.

During teaching and learning of fractions in Grade 7, presented by Mr Jones, it was discovered that Grade 7 learners have a deeper understanding of common fractions. Learners were working in groups of five.

Mr Jones: *“Class last time we were experiencing challenges in finding between $\frac{1}{2}$ and $\frac{1}{4}$ of Dolly’s mother salary, but I was so happy after using another method, that was hands on activities to find out that you were getting correct answers. Let me give you this activity to check whether you still remember.”*

Mr Jones: *“Let’s say class you are given a chance to choose between $\frac{1}{4}$ of R20-00 or $\frac{1}{2}$ of R20-00 for lunch box, what can you choose?”*

Learners of all different groups showed by nodding their heads, approving that it is possible to find $\frac{1}{2}$ of R20 -00 or $\frac{1}{4}$ of R20-00.

Qhamukile, a learner, from group “B “commented:

Qhamukile: *“Yes, Sir it is possible to find $\frac{1}{2}$ of R20-00 or $\frac{1}{4}$ of R20-00.”*

Mr Jones: *“Let us have somebody from group B to come and show us.”*

Qhamukile rushed to the board to present on behalf of her group. Qhamukile from group B showed their findings from her group:

Qhamukile: *R20-00 is bigger than quarter of R20-00, because $\frac{1}{2}$ takes a bigger R20-00. So let me show you using demonstrations.”*

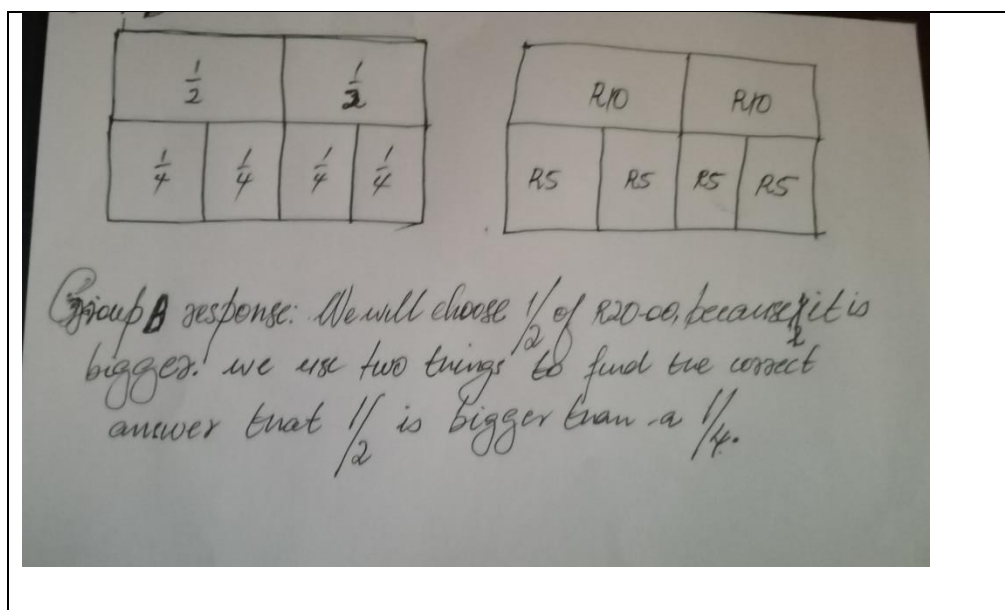


Figure 4.10: Group B's response

Mr Jones: "This is good, your diagram gives us a full picture of what is happening."

Sihle from group A commented as follows:

Sihle: "This is very interesting we also got the same answer but using different method."

Mr Jones: "That's good your approach shows that you have developed conceptual understanding of common fractions."

Look at the way Mr Jones is presenting his lesson: " $\frac{1}{2}$ of R20 – 00 or $\frac{1}{4}$ of R20-00," he manages to use a teaching strategy to link his lesson with the day-to-day life that makes it easy for the learners to understand common fractions. This concurs with Anthony and Wilshaw who states that for subject-matter to be meaningful and understandable the teacher has to integrate the teaching and learning of common fractions with the daily experience of the learners, and the teacher uses money to try and concretise the situation (refer to Section 2.4.2.1). This also concurs with bricolage which states that for effective learning to take place, learners should be involved in cognitive activities to enable the individual to retrieve and recombine previously unrelated knowledge they already possess (Phillimore *et al.*, 2016:2).

From the above statement, "after using another method," it is evident that the teacher was using different modes of teaching styles to accommodate the various learners so as to gain a conceptual understanding of common fractions. This is in line with bricolage which

encourages multiplicity to accommodate diversity (refer Section 2.2.1.3.). The phrase, “*Let us have somebody from group B to come and show us,*” shows that the teacher is trying by all means to act as a facilitator by allowing the learners to be actively involved in the process of knowledge creation and lead learners to discover things for themselves, which also promotes critical thinking.

The learner’s response in Figure 4.10 above shows that the learners have conceptualised common fraction concepts. This is shown by the way learners have concretised their approach in finding the correct answer in Figure 4.10. Learners were inductive in their approach because they were able to draw information from their day-to-day life experience and use it to solve abstract and complicated common fraction problems from Mr Jones’ words, “*This is good*”. It shows that Mr Jones is satisfied and is showing appreciation with learners’ work and at the same time, he is trying to motivate and instil enthusiasm and positive self-esteem to learners.

In conclusion, the findings above show that Mr Jones was successful in his teaching and learning of common fractions. He succeeded in employing teaching instructions that accommodate different types of learners learning styles and concretising his teaching and learning of common fractions. As a results, learners were motivated and took an active part in the teaching and learning process. This is confirmed by Budny (2014:3), following the line of argument of Dunn who argue that a match between a learner’s learning style and a teacher’s style leads to an improved learner’s attitude and higher academic achievement. Therefore the literature is in agreement with the empirical data.

4.3.2 Concretisation of fractions

Common fractions are abstract for both teachers and learners. As a result, teachers may teach wrong concepts which may lead to the formations of misconceptions with learners. Teachers should concretise the teaching and learning of common fractions to make it meaningful to learners. According to Nyathi (2013:2-3), using concrete teaching and learning materials makes the lessons more active and provides an effective way for the learners to represent their thinking. McCrory (n.d.:1) adds that if the teacher can use and link concrete objects and abstractions in their classroom effectively during teaching and learning, this can help to reverse misconceptions about common fractions. Furthermore, the DBE through the CAPS document (DBE 2011:10), emphasises the importance of using concrete objects to

teach abstract concepts in common fractions as to promote comprehension of abstract concepts in common fractions.

In one of the classes where the research was taking place, Mr Brown, the Grade 7 mathematics teacher, was playing the role of being the facilitator during teaching and learning of common fractions (addition of fractions with different denominators). Mr Brown divided the learners into groups of five learners per group to access them all. He first showed how to find equivalent fractions using rectangular manipulations. He then demonstrated to learners how to go about adding common fractions with different denominators using rectangle manipulations while constantly posing to give learners to do it in their small groups and ask questions where necessary. Mr Brown presented his lesson:

Mr Brown: *“Class let us make use of the rectangle manipulation to demonstrate the addition of fractions with different denominator.”*

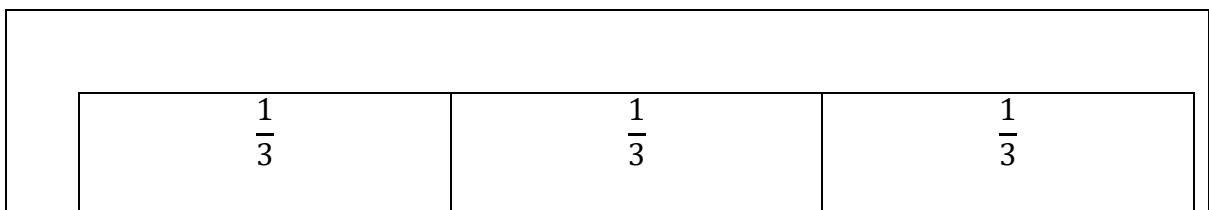


Figure 4.11: Drawing showing one third

$$\frac{1}{3}$$



Figure 4.12: Diagram demonstrating different fractions with one denominator equal to 6

Mr Brown continued:

Mr Brown: *“Class from the demonstration above, you can see that $\frac{1}{3}$ can be written as $\frac{2}{6}$ and also $\frac{1}{2}$ can be written as $\frac{3}{6}$ since they are equivalent, see figure 4.5 above. Class we change our fractions to be equivalent fractions so as to have the same denominator. This will make it easy for us to add this fractions Class?”*

$$\frac{1}{3} = \frac{2}{6}$$

$$\frac{1}{2} = \frac{3}{6}$$

$$\frac{2}{6} + \frac{3}{6} = \frac{5}{6}$$

Figure 4.13: Mr Brown’s classwork

Mr Brown was explaining to the learners while he was posing leading questions to the class.

Mr Brown: *“Any input class?”*

Ntokozo: *“Really Sir your demonstrations make things easy for me.*

Qhamukile: *Thank you Sir for your approach isn’t possible to always have used demonstrations when we learn mathematics.”*

While Qhamukile was talking Senzo interjected

Senzo: *Sir these demonstrations are interesting games for me*

Class: *Can we have more sums?*

Mr Brown wrote the following sums and gave them as group work to do.

The words, *“Class let us make use,”* shows the approach used by Mr Brown is learner-centred, and learners are actively involved in teaching and learning of common fractions. This also indicates that Mr Brown includes learners in the process of knowledge construction and as a result, the learners are empowered. As stated in one of the PAR principles, Mr Brown is deliberately sharing power with his learners and blurring the lines between the learner and the teacher which the intention of empowering his learners (Baum *et al.* 2006:854) (refer to Section 2.4.2). By using rectangular manipulations, Mr Brown is trying by all means to

concretise abstract common fraction concepts. Mr Brown is allowing his learners to penetrate the complexity of common fractions by trying, testing and playing around with rectangular manipulations to learn to solve problems, as a bricoleur (Phillimore *et al.* 2016:2) (refer to Section 2.2.1). The learners in Mr Brown's class seem very excited and interested in Mr Brown's lesson. This is indicated by the words uttered by Ntokozo, Qhamukile and Senzo respectively, "your *demonstrations make it easy*, "*thank you Sir for your approach*" and "*this (sic) demonstrations are interesting*". When learners are interested and excited, they become actively involved in the teaching and learning process.

In conclusion, it is noted that the findings above concur with what Nyathi (2013:2-3) proclaims, that the teaching and learning of common fractions that result from the use of tangible materials make the lessons more vibrant and provide an effective way for the learners to represent their thinking. Hence tangible materials assisted the learners in discovering equivalent fractions for themselves.

4.3.3 Effective use of teaching modalities

Learners are diverse beings from different social and cultural backgrounds; hence they learn differently from different situations. Learners do not always follow their teachers' teaching style; instead, they retain their learning style even if they encounter different teaching styles and different classroom environments (Yassin & Almasri 2015:26). Therefore the teacher must accommodate different types of learners during teaching and learning of common fractions. It is, therefore, the duty of the teacher to find the learners' learning style and try to tailor his or her teaching instructions according to the learners' learning styles (Tuan 2011:290). Peacock (2001:15) further emphasises the importance of striving for a balanced teaching style that does not excessively favour any one learning style, instead rather try to accommodate different learners learning style. DoE (2003:2) emphasises values of sharing, developing self-esteem, building confidence and caring for oneself and others, so teachers are supposed to pay more attention to different learning styles for good performance in common fraction.

During the second period in Grade 7A, learners were ready to present the work that Mr Bhandu gave them to prepare to present on equivalent fractions. Mr Bhandu divided his learners into groups according to their learning style preferences. Those who liked to discuss using pictures were grouped together, those who liked to discuss and write what they are

discussing were grouped together, and the others with other learning styles were also grouped together. They were then given the work to prepare and present it to the class.

Mr Bhandra: *“Class I’ve tried to group you according to the way you prefer to learn. If there is anyone amongst you who feel that the way they learn in your group does not match your style of learning let me know so that I’ll put you in the right group.”*

The work given by Mr Bhandra to the class is reflected below.

Mr Bhandra: *Let us say you are given $\frac{1}{3}$, what are the next 3 equivalent fractions? Is it possible to find the next 3 equivalent fractions class?*

All groups were smiling, and their hands were up, confirming that they could find the next three equivalent fractions.

Mr Bhandra: *It is so surprising to observe your response, to me it seems as if you all understand today’s work. Group A let us have someone from your group to do the sum on the board.*

While Mr Bhandra was talking, Bongani interrupted:

Bongani: *“Sir, this work is well understood by our group.”*

Mr Bhandra: *“That’s wonderful!”*

Bongani with his group started by whispering, delegating duties to group members. Bongani was the first to do the sum on the board and Phume the second:

Bongani: *“This is how we did this sum in our group. We started by using $\frac{2}{3}$ as our starting point. As follows: Note that we all know that if you want to find equivalent fractions you are supposed to multiply by one but in the fraction form as follows:”*

$$1 = \frac{2}{2}, \quad 1 = \frac{3}{3}, \quad 1 = \frac{4}{4}$$

$$\frac{2}{3} \times \frac{2}{2} = \frac{4}{6}, \quad \frac{2}{3} \times \frac{3}{3} = \frac{6}{9}, \quad \frac{2}{3} \times \frac{4}{4} = \frac{8}{12}$$

Figure 4.14: Bongani’s explanation to the class

After Bongani finished doing and explaining the sum on the board, Phume took over and explained the sum using a different approach.

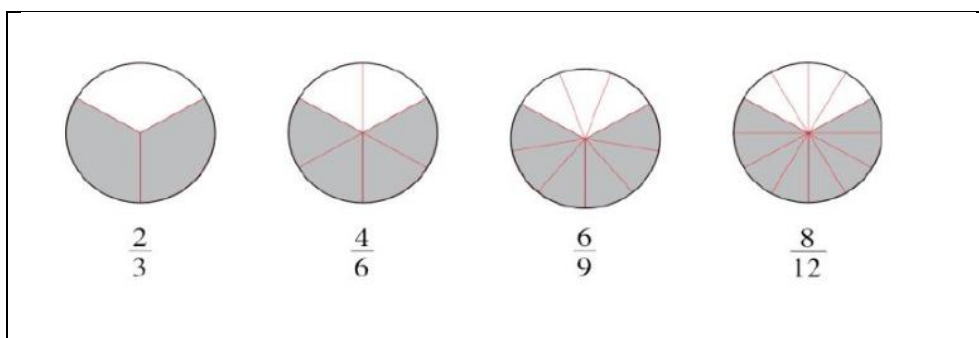


Figure 4.15: Phume’s explanation to the class

Phume:

“Class, let me do this sum using different approach. I will use fraction circle to explain equivalent fraction. In the fraction circle the numerator is represented by shaded area of the fraction circle and the denominator is represented by all pieces of fraction circle that is shaded plus unshaded area. She continue doing the sum on the board while explaining.”

Mr Bhandu remarked:

Mr Bhandu:

Wow! What a wonderful presentation. Everything you did was so exciting, really I’m so proud about you. Your approach to equivalent fractions was very good.

Mr Bhandu’s action of dividing learners into groups according to their learning styles indicates that Mr Bhandu as bricoleur understands that learners are diverse and they learn differently. It is evident from Mr Bhandu’s words, *“to group you according to the way you prefer to learn”*.

This also empowered the learners and promoted peer teaching where learners were working collaboratively in small groups. As the PAR principles stated about collaboration, they worked in their level without being afraid of being scorned by others (refer to Section 3.2). By working in groups and sharing responsibilities, learners developed interest, and this promoted active learning which enhanced the understanding of common fractions. This was also confirmed by the literature that learners do not follow the teacher's teaching style, but it is the teacher that is supposed to diagnose learners' learning styles and tailor his or her teaching instructions according to the learners' learning style (Yassin 2015:26) (refer to Section 2.4.3).

When Mr Bhandu gave the learners work to do on the board, all the learners put up their hands showing that they have understood the work that they did in groups where they were allocated according to each learner's learning style. This is evident from Bongani's words "*this work is well understood by our group*". When Mr Bhandu gave Bongani's group an opportunity to send someone to do the work on the board, the responsibility was shared among the group members and different approaches were used to write the same sum. This indicated that learners did not only memorise laws, rules and procedures for doing the sum but also developed a deeper understanding of equivalent fractions. This is also evident from Bongani's words, "*well understood*". Mr Bhandu, in his words "*that's wonderful*" showed satisfaction with his learners' work. Bongani's words, "*How we did the sum in our group*" showed that Bongani was not working in isolation. It indicates the teamwork and collaboration amongst Mr Bhandu's class to enhance understanding of equivalent fractions. This is in line with the principle of PAR and constructivism that knowledge is socially constructed (refer to Section 2 Section 3.) .Bongani and Phume have used different approaches (teaching instructions) which accommodated different learners' learning styles to improve learning the understanding of the learning of equivalent fractions. This evident from Phume's words, "*using different approach*". Phume's words "*use fraction circle*" indicated that Phume was trying to penetrate the complexity of equivalent fractions by concretising her approach by using the fraction circle.

The use of learning modalities has been proven to play an important role in enhancing the teaching and learning of equivalent fractions. Using teaching and learning modalities helps to accommodate different learners' learning styles, and this develops the interest in learners, and ultimately, learners become actively involved in the teaching and learning process. This is confirmed by the literature of Carol and Burke (2010:66), which is in agreement with the empirical data.

4.3.4 Importance of pedagogical content knowledge in teaching and learning of common fractions

Pedagogical content knowledge (PCK) has been identified as one of the key factors in alleviating challenges in the teaching and learning of common fractions. Koehler and Mishra (2006:1027) define pedagogical content knowledge as knowledge of teaching strategies that integrate appropriate conceptual representations to address learners' difficulties and misconceptions and to foster meaningful understanding. For teachers to enhance their PCK, they need to undergo professional development to improve their method of teaching (Morais & Naves 2001:21). Furthermore, the DoE (2003:10) emphasises the importance of interaction between the content knowledge of the teacher and the learner's background to improve learners' understanding of the concepts.

Mr Bhandu is teaching Grade 7 in common fractions. He is explaining the content to learners, linking the learners' preconceptions with the new knowledge, using different methods including charts, paper strips and different tangible materials. He is trying to make his demonstrations as clear as possible to the learners, and he is more concerned about active participation in teaching and learning of fractions.

At the site of investigation where Mr Bhandu was teaching the division of common fractions, he gave activities to the learners and asked them to explain to everyone while doing it on the board, while the lesson progressed as reflected below.

Ntombi: *"It is a pleasure to me to share ideas that we discussed with my group I can interpret the sum $3 \div \frac{1}{3}$ as how many $\frac{1}{3}$ are there in 3 slices? Let me start by using drawing, while I'm talking let me start by dividing the slice into thirds ($\frac{1}{3}$) (while drawing on the board) she started dividing each slice into 3 equal parts. How many thirds ($\frac{1}{3}$) do we have in total?"*

Class: *"9 [in chorus]"*

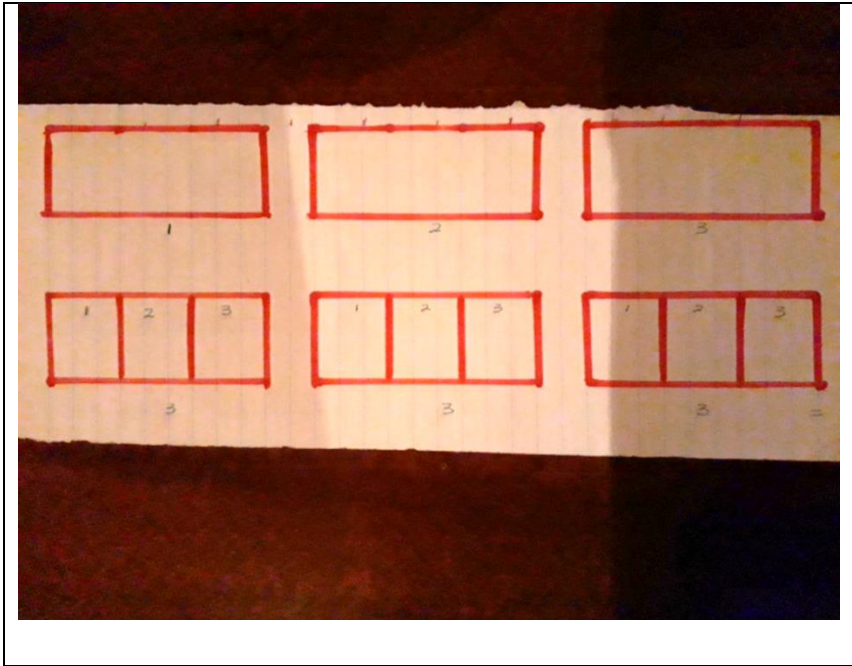


Figure 4.16: Demonstrating $3 \div \frac{1}{3}$

Mr Bhandu: *“Wonderful, the way you presented it was excellent. Give her a round of applause.”*

Learners: *“Clapped the hands shouting.”*

Bongani interjected:

Bongani: *Let me show you another method (rushing to the board and write the sum while explaining).*

$$\begin{aligned}
& 3 \div \frac{1}{3} \\
&= \frac{3}{1} \div \frac{1}{3} \\
&= \frac{3}{1} \times \frac{3}{1} \\
&= \frac{9}{1} \\
&= \underline{9}
\end{aligned}$$

Figure 4.17: Bongani's demonstration

$$3 \div \frac{1}{3} = 9$$

Qhamukile: *"Bongs, why can you please explain to me the reason of changing the sign from division to multiplication sign?"*

Bongani: *"I think the law states it clearly that we need to change the sign and invert the fraction on the right."*

Qhamukile: *"Why Bongs why, why?"*

While they were arguing, Mr Bhandu reappeared:

Mr Bhandu: *"Let me intervene, from Ntombi's presentation, she cuts pieces. How many pieces were there before cutting?"*

Learners: *"Three [simultaneously]"*

Mr Bhandu: *"How many pieces were there after cutting?"*

Learners: *"Nine."*

Mr Bhandu: *"Did the number of pieces increase or decrease after cutting?"*

Learners: Increase *"Mr Bhandu: What actually happen in this situation?"*

Bongani quickly got in.

Bongani: *“The number of pieces increased to nine. It means they have multiplied by three. I think I got the reason of changing the sign from division to multiplication.”*

Mr Bhandu: *“Let us start by applauding Bongani for a fruitful contribution. Clapping of hands.”*

Mr Bhandu: *“That is true Bongani, when you divide the number by the fraction it multiplies. Meaning that if you divide a whole you cut it into more pieces so, it multiplies, that is part of the reason why division sign changes to a multiplication sign.”*

From the extract *“It a pleasure to me to share with you our ideas that we discussed with my group”* it is clear that all the members of the group owned the idea. The word “we” indicated these learners were working together and helped each other when solving the problems. This means that Mr Bhandu has succeeded in instilling a culture of collaboration and inclusivity in his class with all contributing towards a problem-solving activity. This is still in line with the principles of PAR, which encourages collaboration and group work (refer to Section 3.2.4). The words uttered by Ntombi and Bongani, *“Let me start by using drawings”* and Bongani *“Let me show you another method”* indicated that Mr Bhandu had good teaching strategies which indicated good PCK. This is indicated in that Bongani’s group and Ntombi’s group approached the same sum in different ways, and both succeeded in getting it correct. Bongani’s approach was good for auditory learners, while Ntombi’s approach was good for both auditory and visual learners. Mr Bhandu can be taken as a bricoleur because of his diverse approach to the teaching and learning of common fractions. All this can be attributed to Mr Bhandu’s good PCK.

From the activity that Mr Bhandu gave to the learners *“how many $\frac{1}{3}$ are there in 3 slices,”* we can see that Mr Bhandu is using problems from a real-life situation. In the class activity that he gave to the learners, Mr Bhandu successfully linked the content and the context of the learners to understand and answer the questions. Approaches from both Bongani’s group

and Ntombi's displaying of Mr Bhandu's diverse strategies to teaching and learning of common fractions show the deeper PCK. From the above approach, you can tell that Mr Bhandu has a deeper conceptual understanding of common fraction concepts. This is also confirmed in the literature by Sibuyi (2012:9) who posited that for teachers to teach mathematics effectively, it is imperative for them to possess a deeper PCK. Mr Bhandu was able to empower his class. When Qhamukile and Bongani argued about the reason for changing the sign when dividing fractions, Mr Bhandu intervened and explicitly explained that the sign was changed when dividing fractions because the number of pieces increases (multiply) when dividing fractions, which showed that he has a deeper understanding of these concepts.

It is important that the teacher should possess deeper pedagogical content knowledge to equip learners with relevant knowledge of common fractions. The literature confirms what was found from the empirical data.

4.4 CONDITIONS CONDUCIVE FOR A SUCCESSFUL IMPLEMENTATION TO IMPROVE THE TEACHING AND LEARNING OF FRACTIONS

This section considers the conditions that are conducive for the best implementation of the solution of the approach deliberated in Section 4.3. The solutions and approaches in Section 4.3 are ready to be implemented beyond the period of the study. Therefore, it becomes crucial to find conditions that are conducive to sustain the solution even after the study has reached its conclusion.

4.4.1 Proper teaching and learning of common fractions

According to the DBE in the CAPS statement, a deep conceptual understanding of common fractions is needed to make sense of mathematics (refer to Section 2.7.1) (DBE 2011). Therefore, common fractions should be properly taught in such a way that it makes sense to learners to eliminate misconceptions that might emerge from improper teaching of common fractions. Hence the teacher must identify learners' misconceptions for the teachers to tailor their teaching strategy in a manner that will alleviate learners' misconceptions. Mdaka (2011:5) further argues that the mistakes that are made by the learners should not be dismissed as wrong thinking, but should be used as necessary stages of conceptual development since they may indicate alternative ways of reasoning.

During the meeting that was held in the Grade 7 class with team members, the team discussed what would be conducive for teaching and learning of common fractions in the Grade 7. Mr Magudulela came up with the following response.

Mr Magudulela: *“It is important that the teacher should give the chance to the learners to say what they know and think about the common fractions concept.”*

Ms Binda: *“You are correct Mr Magudulela. I think that can help us to find the common mistakes that learners committing when dealing with common fractions.”*

Mr Madonsela: *“We can come up with ideas that we can use in class to help each other.”*

The words uttered by Mr Madonsela, *“should give chance to learners,”* indicate that Mr Madonsela believed that learners should be allowed to take an active part in the process of knowledge construction during teaching and learning of common fractions. This means Mr Madonsela does not take learners as empty vessels to be filled with information from the teacher. Furthermore, from Mr Madonsela’s words, one can argue that he is of the notion that the teacher should refrain from just being concerned about how he covered the content material. Instead, he should be concerned about how he shared the content material with the learners. This is in line with PAR that emphasises the importance of collaboration and co-construction of knowledge (refer to Section 3.2). This is in line with the view that learners should not just be seen as empty vessels to be filled with information from the teacher but as co-constructors of knowledge. The teacher should not only be concerned with how he covers the content material but with how he shares the content material with the learners.

From the above extract *“to say what they know and think”* shows that the teacher is allowing the learners to actively participate in the teaching and learning of common fractions. When learners are saying something, they argue and voice out their thinking about common fractions. When arguing, learners voice out their mistakes and misconceptions that they have about the common fraction concepts. This will assist the teacher in correcting the learners’ misconceptions and building on them to develop a deeper understanding of common fractions (DBE 2018:3). As stated by bricolage, by doing this, the teacher is turning learners’

weaknesses into strengths by identifying learners' misconceptions and building a sound understanding of common fractions on them (Refer to 2.2.1.5).

In conclusion, the empirical data concurs with the literature that the teacher should allow learners to be actively involved and argue about these concepts during the teaching and learning of common fractions. This will allow the teacher to identify the misconceptions that the learners have about common fraction concepts and alleviate these mistakes.

4.4.2 The use of concrete objects.

DBE (2018:9) states that conceptual knowledge enables learners to apply ideas and justify their thinking. This will be possible if mathematics teachers can use tangible objects to encourage self-discovery and to increase insight into the learners (Mchunu 2016:3). This is further corroborated by the work of McNeil and Jarvin (2007:17) who argue that concrete objects assist learners to make the connection from real objects to their abstraction. In addition, the theory of constructivism further suggests that learners must be actively involved in the development of their own understanding (Van de Walle 2004:24).

On the research site, Miss Zondi used the concrete-representational-abstract (CRA) approach to enhance teaching and learning of common fractions. The learner participation was outstanding, as learners were actively involved throughout the learning sessions.

Miss Zondi arrived at the Grade 7A class to teach fractions.

Miss Zondo:

"Today we are going to learn about fractions."

She put five balls on the table, two blue and three green balls.

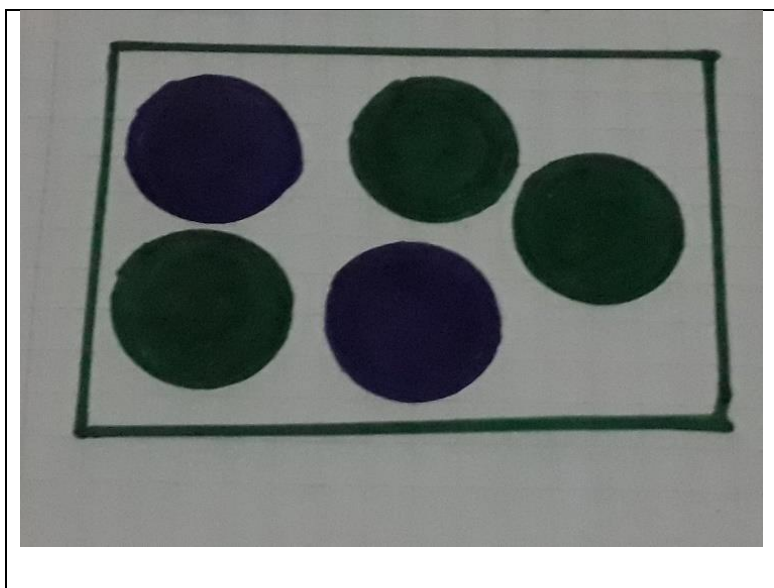


Figure 4.18: Blue and green balls.

- Miss Zondi: :We represent fraction as $\frac{\text{part}}{\text{whole}}$
 How many balls in total on the table?"
- Learners: "Five madam."
- Miss Zondi: "In fraction part represent the numerator and the whole represent
 the denominator, how many blue balls on the table."
- Learners: "Two."
- Miss Zondi: "We write two as a numerator , $\frac{2}{5}$
 How many balls in total ? "
- Learners: "Five madam."
- Miss Zondi: "We write five as a denominator, $\frac{2}{5}$, then this fraction become $\frac{2}{5}$,
 which is two parts out of five whole."

From the above extract the word "we" indicates that Miss Zondi's intention is to include learners in her lesson so that learners can take an active part in the process of co-construction of knowledge about common fraction concepts. Apparently, Miss Zondi is aware that learners are not empty vessels; hence she empowers them by involving them in her lesson (refer to Section 2). From Miss Zondi's utterances, "how many," one can deduce that Miss Zondi as a bricoleur is acting as a facilitator allowing learners to work collaboratively in penetrating the complexity of common fraction concepts (refer to Section 2.) The expression " $\frac{\text{part}}{\text{whole}}$ " shows that Miss Zondi is trying to concretise her lesson, by moving from the known (learners daily experiences) to the unknown (common fraction concepts).

In conclusion, the empirical data supports the findings of the literature that concrete objects can assist learners in developing a deeper understanding of common fractions. The work of Mdluli indicated that knowledge could be brought in by using practical demonstrations, drawings, and pictures to teach fractions and support learners in constructing new knowledge (Mdluli 2013:10).

4.4.3 Effective use of modalities in teaching and learning of common fractions

The DBE (2013:2) asserted that effective use of modalities during teaching and learning of common fractions helps to accommodate different learners' learning styles that cater for the diverse nature of learners; as a result, the teaching and learning of common fractions is enhanced. At the same time, the work of Chamane (2016:9) emphasises the importance of diversifying teaching strategies to accommodate different types of learners that are in the class. The theory of constructivism further proclaims that teachers should present common fractions in a way that cater for different learners' learning styles to accommodate the different ways in which the learner assimilate, accommodate and equilibrate common fraction concepts (Woollard & Pritchard 2013:3).

Miss Xulu arrived at the Grade 7 A class to present the lesson on the subtraction of fractions.

Miss Xulu: *"Last time we added fractions and today we are going to do subtraction of fractions. What is the first step in adding fractions?"*

Learners: *"Finding the LCM."*

Miss Xulu *"Same applies to subtraction, we first find LCM."*

Miss Xulu proceeded to explain and asking questions from learners until she received the answer. She also used fraction strips as an alternative method. After explaining the sum on the board, she gave them the sums to do in groups.

Miss Xulu: *"We are going to use different approaches for this sum. Those who wants to do the sums using strips, let them form their group and those who wants to use rules and laws must also form their own group."*

She then gave them the sums to do in groups.

4.4.4 Effective pedagogical content knowledge

PCK is essential for effective teaching and learning of common fractions (Sibuyi 2012:11). The DoE (2005:16) also suggested that teachers should display a deeper pedagogical content knowledge by involving learners actively in the classroom by facilitating learning, using a variety of learner-engaging methods during teaching and learning of common fractions. Shulman (1985:47) (refer to Section 2.4.4) believes that teaching requires broad and highly organised bodies of knowledge.

In one of the lessons Miss Zondi came to the class and displayed what was believed to be the good PCK. She started her lesson by testing her learners pre-knowledge to identify the mistakes (misconceptions) that learners had about common fraction concepts. Learners were divided into groups to discuss and share their knowledge. Each group was given a chance to send a delegate to show their group approach to doing the sum. Themba was delegated from Group A to come and do the sum $\frac{3}{4} \times \frac{3}{5}$ on the board

He proceeded as follows:

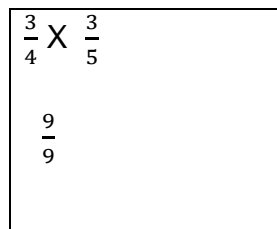

$$\frac{3}{4} \times \frac{3}{5}$$
$$\frac{9}{9}$$

Figure 4.19: Themba's group

Themba: *"According to our group, the first thing is to multiply numerators and then add denominators and then we find the answer which is $\frac{9}{9}$."*

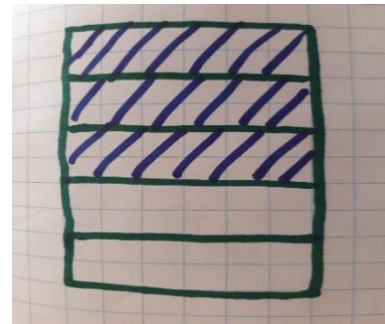
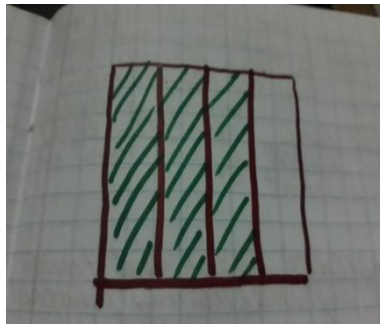
Miss Zondi: *"Group A why do we multiply the numerators but add the denominator?"*

Group A: *"We multiply because there is a multiplication sign."*

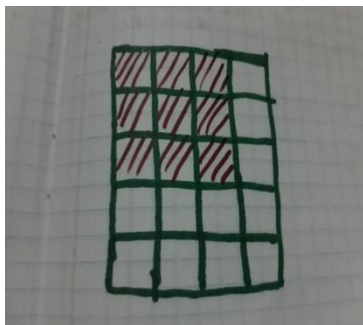
Miss Zondi: *"Why do you add the denominators?"*

Miss Zondi went checking group by group if they had the same approach to the sum. She discovered that some group added numerators and denominators, and some multiplied the numerators and found the LCD of denominators.

After Miss Zondi identified the common mistakes, she started teaching the multiplication of common fractions using manipulations and procedures. She started with the sum on the board.



$$\frac{3}{4} \times \frac{3}{5}$$



How many boxes are shaded? 9

$$\frac{3}{4} \times \frac{3}{5} = \frac{9}{20}$$

a

How many boxes are there in total? 20

Figure 4.20: Demonstration of multiplication

$$\frac{3}{4} \times \frac{3}{5}$$

Miss Zondi started explaining multiplication of common fractions to the class. She tried to concretise her lesson by using the area model, to enhance the understanding of multiplication of common fractions.

Miss Zondi: *“Figure 4.11 represents $\frac{3}{4}$ and figure 4.12 represents $\frac{3}{5}$. Numerators are represented by shaded boxes, while denominators are represented by both shaded and unshaded boxes.”*

Thabo: *“Madam do you mean that in both figure 4.11 and figure 4.12 represents the numerators.”*

Miss Zondi: *“Ok class to find the product in figure 4.13. The numerator which is equal to 9 is represented by shaded boxes while 20 which is the denominator, is represented by both shaded and unshaded boxes.”*

Zama: *“How do we know that we are supposed to write 9 shaded and 20 boxes in total?”*

Miss Zondi: *“3 shaded boxes in figure 4.11 is multiplied by 3 shaded boxes in figure 4.12 (numerator) and give 9 shaded boxes in figure 4.13 and the total number of boxes in figure 4.11(shaded and unshaded boxes) is multiplied by total number of boxes in figure 4.12(shaded and unshaded) is equal to 20 boxes(denominator)”.*

She then gave learners other sums to do on the board and encouraged them to work collaboratively in groups.

4.5 THREATS TO THE IMPLEMENTATION OF THE STRATEGIES FORMULATED IN IMPROVING THE TEACHING AND LEARNING OF FRACTIONS IN GRADE 7.

In this section, the discussion will be on threats to the implementation of the strategies formulated to improve the context-based in teaching and learning of common fractions. The components of the emerging strategy were examined at length in Section 4.3. The components of improving the understanding of common fractions, the concretisation of common fractions, effective use of teaching modalities and the importance of PCK in teaching and learning of common fractions. This section will discuss the threats to the teaching and learning of fractions, namely, limited time allocated during the teaching of common fractions, teaching common fractions in an abstract way and insufficient knowledge about the use of modalities and inappropriate staffing.

Time constraints are one of the threats that contribute to hindering learners' understanding of common fractions during teaching and learning of common fractions. According to the CAPS (DBE 2011:5), inclusivity should become a central part of the organisation, planning

and teaching at each school. The theory of instruction emphasises that this can only happen if all the teachers have a sound understanding of how to recognise and address barriers to learning, and how to plan for diversity (Hoong, Kin, & Pien 2015:5) Teachers are experiencing challenges in accommodating all the different types of learners due to insufficient time and different learning abilities during teaching and learning of fractions that can lead to poor conceptualisation and poor performance (Moodley 2008: 424).

4.5.1 Teaching common fractions in an abstract way.

An approach that teacher use for teaching can be a threat to teaching and learning of common fractions. Sometimes teachers approach to common fractions can be so abstract in such a way that it results in the formation of misconceptions in learners' minds. Some teachers concentrate on procedures and rules neglecting conceptual understanding of common fractions (refer to Section 4.). Sometimes the teachers can struggle to use manipulations in a way that meet their objectives (learners' learning styles). The theory of instruction recommends the use of concrete representational abstract (CRA) teaching to benefit the struggling learners (Hoong *et al.* 2015:1). A significant amount of class time should be spent on developing mathematical ideas and methods rather than only practising fraction skills (National Academy Press 2001:425).

4.5.2 Insufficient knowledge usage of modalities.

Improper usage of teaching modalities can be one of the threats in teaching and learning of common fractions. It is therefore important that teachers should make good use of modalities during the teaching and learning of common fractions to accommodate learners' learning differences to enhance teaching and learning of common fractions (Awla 2014:242). Learning and skill development are enhanced if teachers recognise differences and vary instruction accordingly.

4.5.3 Inappropriate staffing

Sometimes teachers find themselves in a situation where they have to teach mathematics even if they did not specialize in it. This imposes a threat in learners' understanding of challenging concepts like common fractions since the teacher does not possess enough mathematics PCK as National Academy Press (2001:428) indicated that the knowledge required teaching mathematics well is specialised knowledge. According to Ward and Thomas (2006:128) the teacher with insufficient PCK concentrates on algorithmic or rule-

based understanding of common fraction concepts without a deeper understanding of these concepts; as a result, misconceptions are formed in learners' minds.

In the conversation between Miss Zondi and Mr Gagashe during my research days, this is what they had to say:

Miss Zondi: *"It is important that we, as mathematics teachers make sure that these learners understand common fraction concepts so that they will be motivated."*

Mr Gagashe: *"If you can let them know the rules by heart Madam, I think most will pass."*

Miss Zondi: *" I think if we can also concrete object to teach some concepts that will be better."*

Mr Gagashe *"You must remember that I specialised in Geography, I do not know what you are talking about."*

4.6 INDICATORS OF SUCCESS FOR THE STRATEGY FORMULATED

One of the objectives of this study was to respond to the identified challenges of using context-based strategy in the teaching and learning of common fractions. The success of this study is noticed when the teachers who participated in the study demonstrate a deep conceptual understanding of common fractions when facilitating and designing lessons using different types of learning styles to accommodate the diverse learners that are in the class during the teaching and learning of common fractions.

4.6.1 Common fractions content is easily accessible to learners

According to the DBE (2013:6) and the Singapore Ministry of Education (2013:8), all learners should have access to basic education, particularly in the learning of common fractions. Teachers teaching common fractions should make sure that they are meaningful, fun and relevant towards the needs of the learners. According to the literature (refer to Section 2.4.2.1) for the subject matter to be meaningful and understandable to the learner the teacher has to integrate the teaching and learning of common fractions with prior knowledge of the learner. Furthermore in active learning, learners are given an opportunity to think, talk, write and do something about what they are learning and to reflect on what they are doing (Sekwena 2012:16) through the variety of activities.

On the research site, the learners were given the following class activity on the board by Mr Bhandu to subtract common fractions with the same denominator: $\frac{4}{5} - \frac{2}{5}$ The class activity was as follows:

Mr Bhandu: *“Last time we were busy subtracting common fractions with the same denominator, now I want to see whether you did understand, or not.”*

One of the learners commented:

Qhamukile: *“I can quickly show the class, it is easy because the denominators are the same.”*

Zama supported the argument raised by Qhamukile:

Zama: Yes Qhamukile I was also thinking about that, we are used to do difficult sums this is too easy.

Qhamukile’s response towards the given sum

$$\frac{4}{5} - \frac{2}{5} = \frac{2}{5}$$

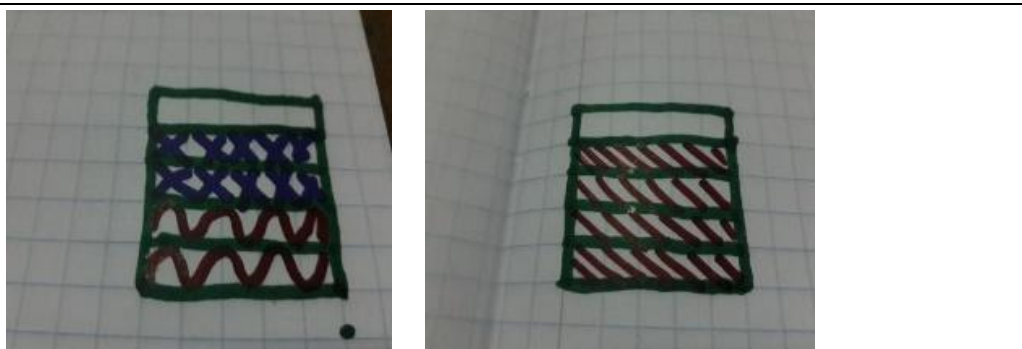


Figure 4.21: Demonstrating subtraction

$$\frac{4}{5} - \frac{2}{5} = \frac{2}{5}$$

4.6.2 Common fractions become concrete and meaningful to the learners.

The DBE (2016:134) develops, maintains and supports the South African school education system for the 21st century by encouraging teachers and learners to use concrete objects in teaching and learning of fractions. Rosli, Goldsby, and Capraro (2015 :1718) is of the view

that in mathematics classrooms, teachers use multiple representations to help learners to explore and develop abstract concepts.

Concrete representational abstract objects play an important role in enhancing meaningful understanding. Therefore teachers are encouraged to use it as an appropriate tool to make common fractions easier.

4.6.3 Good use of modalities.

DBE (2017:6) encourages teachers to be lifelong learners and make sure that learners are given special support to learn to their fullest capacity by using different practical tools (learning styles) for all learners, ensuring accessible lessons, teaching strategies, assessments and learning support material. The modality theory also concurs that learners do differ in their abilities and also encourages teachers to use different practical tools for all learners that are in the class (Willingham 2005:36). Furthermore the work of Awla (2014:242) acknowledges that all learners are different, their differences influence how they learn and teachers are capable of assisting all learners in the class to achieve their full potential. Good use of modalities should be emphasised to enhance learners learning (Willingham 2005:31).

4.6.4 Teachers display deeper understanding of PCK.

The National Council of Teachers of Mathematics (NCTM) (2000:1) encourages teachers to use many approaches during the teaching and learning of common fractions. Gardner's theory of multiple intelligence states that intelligence is comprised of a group of different abilities (Weiler 2004:49). That is why mathematics teachers should display a deep understanding of pedagogical content knowledge of common fractions to teach common fractions effectively. A poor knowledge of fractions in primary schools leads towards low performance and makes learners learning not easy or enjoyable (Carter 2000:1; Abadzi, 2006:19).

4.7 CHAPTER SUMMARY

This chapter dealt with the analysis of the data, as well as the presentation and interpretation of results and findings on the strategy to design the framework of teaching and learning of common fractions in Grade 7 using a context-based approach. The chapter also focused on how the data was analysed, interpreted, presented and discussed. This was in line with the objectives of the study as mentioned in Chapter 1. There were many sources, together with the information sessions, in which we, as co-researchers, together showed that there was a

need for the formulation of such a strategy. The information identified the challenges that learners are experiencing in learning common fractions in Grade 7. The solutions to overcome problems concerning teaching and learning of common fractions were discussed. In addition, the conditions necessary to make the strategy work were considered. Furthermore, threats were identified that could lead the strategy to be unsuccessful. Everything was done in consideration of the objectives of the study.

5 CHAPTER 5: FINDINGS, RECOMMENDATIONS, SUGGESTIONS FOR FUTURE RESEARCH.

5.1 INTRODUCTION

The study aimed to develop a strategy to improve the teaching and learning of common fractions with the aid of a context-based approach. This section begins by restating the background of the study, the problem under investigation and the objectives of the study for ease of reference for the reader. Afterwards, the chapter offers the findings of the study arranged as per the objectives of the study. I formerly present the phases of a confirmed and implemented strategy, which appears as a recommendation for all encounters that developed during the investigation procedures. Conditions that are conducive and possible threats for the strategy to improve the implementation of teaching and learning of common fractions using a context-based approach are outlined. Lastly, the indicators of success will be presented.

5.2 BACKGROUND OF THE STUDY

This study aimed to design a framework for the teaching and learning of common fractions in Grade 7, using a context-based approach. In South Africa, learners are experiencing difficulties with conceptualising common fractions, i.e. learners are not able to relate common fractions to real-life situations (Maphini 2019:3; Quigley, Herro 2019:3; Sierpinska 2019:24). This is because learners are taught in a deductive way, which limits the opportunity for learners to discover things for themselves (Brown & Quinn 2007:24; Conley 2014:439). On the other hand, in Egypt, the work of Loveluck (2012:2); Kilpatrick, Swafford, and Findell (2001:118) indicates that pedagogical methods and approaches in teaching are also problematic. The learners are encouraged towards memorisation and rote-learning, learners being the passive receivers of information which results in poor understanding of fraction concepts. This is also seen in the United States of America where learners are experiencing difficulties in the adding and subtracting of common fractions with different denominators e. g. reaching the wrong conclusion that $\frac{1}{2} + \frac{2}{3} = \frac{3}{5}$ (Dhlamini & Kibirige 2014:237; Gabriel *et al.*, 2013:15). Learners do not understand why the lowest common denominators (LCD) are needed when adding and subtracting fractions (Carrillo *et al.*, 2013:2986; Gabriel *et al.* 2013:15); hence, there is a need to design a framework for teaching learners' common fractions using a context-based approach.

Maharaj *et al.* (2007:600) and Mdluli (2013:3) confirmed that more practical demonstrations on fractions must be done for learners so that they can improve their conceptual understanding. On the other hand, learners in Nigeria are encouraged to use their existing knowledge and critical thinking to solve problems involving fractions, for themselves with understanding and not through memorising concepts (Rasheed, & Ogundokun 2016:1). Research by Fazio and Siegler (2011:12) and Arcavi (2003:216) argues that in the United States of America (USA), visual representations can be used to help teachers illustrate common denominators when adding and subtracting common fractions, e.g. by using concrete objects to demonstrate that $\frac{1}{3} + \frac{1}{2} = \frac{5}{6}$. Brown and Quinn (2007:34) and Simon (2006:370) confirm that the use of partitioning and repeating will assist learners in understanding the meaning of numerators and denominators.

According to Fazio and Siegler (2011:6), Clausen-May (2005:1) and Kolb and Kolb (2005:195), teachers can use different teaching strategies on fractions in their variety of classrooms to create a conducive atmosphere which will help to eliminate poor conceptualisation of fraction concepts. On the other hand, learners in Nigeria are learning under the condition whereby learners are allowed to think for themselves and construct meaning from existing knowledge and real-life situations to solve fractions problems (Brown & Quinn 2007:27; Molefe & Brodie 2010:4). However, in the USA, learners work collaboratively by sharing ideas (Marake 2014:186). The teacher only explains if clarity is needed on how to find the common denominator (Fazio & Siegler 2011:3).

The insufficient time allocated during the teaching of fractions can lead to a poor conceptualisation of concepts due to different learning abilities (Siegler & Forgues 2015:19). This can lead to poor performance for learners who need more time to learn a new concept (Adendorff & Moodley 2014:424). In the RSA, according to the findings by the Southern and Eastern African Consortium for Monitoring Educational Quality (SACMEQ) III report of 2007, teachers have insufficient content knowledge (CK) because they experienced difficulties in answering question papers of Grade 6 learners on the subject of fractions (Spaull 2013:4). In addition, the work of Chan *et al.* (2007:27) confirms that poor performance concerning fractions, particularly, in adding and subtracting fractions due to insufficient pedagogical content knowledge (PCK), will lead to poor performance on fractions. In overcoming the above-mentioned threats, teamwork and workshops need to be in place, and it must be

ensured that teachers are placed according to their field of specialization (Ball *et al.* 2005:21, Carrillo *et al.* 2013:2985;).

According to the DBE (2014:40), it was observed that learners perform well in the addition and subtraction of fractions. The evidence was indicated by an Annual National Assessment (ANA) report from 2012–2014, done on Grades 3, 5 & 6. Results on fractions ranged respectively from average marks of Grade 3: 41%, 53%, & 56%; Grade 5: 30%, 33% & 37%; Grade 6: 27%, 39% & 43%. These results were obtained by using the approach of context-based strategy in the teaching and learning of fractions. However, in Nigeria, there was a great improvement in learner performance due to the effective teaching methods on fractions. The evidence was indicated by the marks obtained by Grade 4 learners in 2009 and 2012, with the scores on fractions being 25% in 2009 and 39% in 2012 (Sa'ad, Adamu & Sadiq 2014:32). However, in the report published by Trends in International Mathematics and Science Study (TIMSS) (2011:9), Singapore scored 43% using the concrete, pictorial abstract (CPA) approach to the teaching of the subject, far more than other countries, including Japan, Hong Kong and China. Other countries scored up to 30% less in fractions; hence Singapore's results seem to have benefitted because of the concrete, pictorial abstract (CPA

5.2.1 Problem statement

Fractions have been used for centuries and are still being utilised in a great variety of everyday life situations and mathematics. Yet, they are hard for learners to grasp and master (Gabriel *et al.* 2013:1). Learners experience difficulties in understanding the conceptual significance of fractions (Chan *et al.* 2007:28). Loveluck (2012:1) and Spaul, (2013:4) further state that learners are experiencing difficulties in adding and/or subtracting common fractions. According to Ayan and Isiksal-Bostan (2019:2) and Chinnappan (2005:241), learners are unable to relate common fraction concepts to their real-life situations. The work of Rau *et al.* (2013:115) and Shin and Bryant, (2015:380) revealed that this result in learners' context conflicted with common fractions content. This makes it difficult for the learners to develop a deeper understanding of common fraction concepts. For these apparent reasons, the researcher found it necessary to conduct her study based on the teaching and learning of common fractions for Grade 7 learners, using a context-based approach.

5.2.2 Research question

The research question is restated for ease of reference:

- How can the teaching and learning of common fractions in Grade 7 using the context-based approach be improved?

5.2.3 Aim of the study

This study aimed to design a framework of teaching and learning for common fractions in Grade 7 by using a context-based approach.

5.2.4 Objectives of the study

- To justify the need to improve effective teaching and learning of common fractions in grade seven mathematics.
- To investigate the solutions that could improve the effective teaching and learning of common fractions in grade seven mathematics.
- To identify conditions for improving effective teaching and learning of common fractions in Grade 7.
- To identify and circumvent threats that may hinder the effectiveness of teaching and learning of common fractions in Grade 7.
- To suggest evidence that improves effective teaching and learning of common fractions in Grade 7.

5.3 FINDINGS AND RECOMMENDATIONS

This section discusses the findings followed by the recommendations as determined in the study.

5.3.1 Findings on misapplication by learners in the teaching and learning of common fractions

During our class visit as co-researchers misapplications of common fractions by learners was observed (refer to Section 4.2.1). Learners treating common fractions as whole numbers make it difficult for them to understand the addition of fractions. Misapplication also seems to be a challenge when arranging common fractions in ascending order. The literature also emphasized this (refer to section 2.4.1). Mdluli (2013:51) confirms that in most cases, these errors happen when learners are taught without the use of hands-on activities.

5.3.1.1 *Recommendations on misapplication by learners in the teaching and learning of common fractions*

Teachers were encouraged to spend more time using concrete objects than stressing rules and procedures. The strategy recommends that teaching strategies should be crafted in a

manner that would accommodate different learners' capabilities (refer to Section 2.2.2.2). Mdluli (2013:51) confirms that in most cases, these errors happened when learners are taught without the use of hands-on activities.

5.3.1.2 *Recommended condition on proper teaching and learning of common fractions*

The study discovered that proper teaching and learning of common fractions should be taken into consideration in such a way that it makes sense to learners so as to eliminate misconceptions that might develop from improper teaching of common fractions (refer to Section 4.4.1). In addition, the teacher should allow learners to argue during teaching and learning of common fractions to feel free to voice out the knowledge that the learner has so as to build to that particular knowledge of the learner to enhance the deeper understanding of common fractions (refer to Section 2.4.3.1). Brown and Quinn (2006:30) asserted that teaching of common fractions that involve visual and verbal reasoning activities was a condition conducive to build a deeper understanding of common fractions in learners.

5.3.2 Findings on adding fractions with different denominators

Lack of a fraction concept contributes to learners' challenges when adding common fractions with different denominators. An aspect identified as a challenge in adding fractions with different denominators, is learners' inability to find the lowest common denominator on their own (refer to Section 4.2.2). This was observed as the struggle for learners to follow the rules and procedures. According to Siegler and Fazio (2013:13), failing to follow rules and procedures result in a misinterpretation of fractions.

5.3.2.1 *Recommendation on the use of concrete objects*

As a team, we agreed that the use of manipulatives could be the solution in adding common fractions with the different denominators. The work by Basturk (2016:35) pinpoints the necessity of using the multiple meanings of common fractions. This will enhance the conceptual understanding of adding common fractions with different denominators (refer to Section 4.2.2). Furthermore, the work of Fazio and Siegler (2011:6) discovered that the recommendations include using a variety of classroom representations and teaching tactics that can be utilised to alleviate the conceptual difficulties in teaching and learning of fractions.

5.3.2.2 *Recommended condition for the use of concrete objects.*

The teaching and learning of common fractions using concrete objects were encouraged by the team members. The work of Mchunu emphasises that mathematics teachers should use

concrete objects during the teaching and learning of common fractions (refer to Section 4.4.2) to encourage self-discovery and to increase insight to the learners. Furthermore, Olympiou and Zacharia (2012:23) argue that concrete objects should be used to enhance learners' understanding of common fraction concepts more than just the use of abstract concepts alone

5.3.3 Teaching modalities and learning styles.

Learners experiencing difficulties in adding fractions with different denominators was discovered as a challenge for teaching and learning of common fractions applications. Hence teachers focus on concepts rather than doing things (refer to Section 2.4.2). This was the results of the teachers failing to accommodate learners with teaching modalities and learning styles, not knowing that all students do not learn in an identical way. This situation obstructed learners from being exposed to a different learning style that would cater to their diverse styles of learning (see Section 2.4.2.3).

5.3.3.1 Recommendation on teaching modalities and learning styles.

As a team, we came up with the solution that the emphasis must be on encouraging teachers to use different modes of teaching styles to teach common fraction concepts, to cater for different learners with varying styles of learning (refer to Section 4.2.4.3). This concurs with Brandenburg who contends that a learner-centred approach should be allowed for the learners to cooperate enthusiastically through teaching and learning of common fractions and to advance their understanding of common fractions (refer to Section 2.4.2.3).

5.3.3.2 Recommended conditions that are conducive to the effective use of modalities in teaching and learning of common fractions.

The study established an effective utilisation of modalities to be a conducive condition in teaching and learning of common fractions. The reason was the different types of learners that were in the class during teaching and learning of common fractions (refer to Section 4.4.3). Teachers are supposed to craft their teaching instructions to accommodate diverse learners that are in the class, by using different teaching styles. In addition, the teacher must allow a different pace for learners since they are not all the same; their pace will also differ from one learner to another (see Section 2.4.3.3).

5.3.4 Findings on Pedagogical Content Knowledge (PCK).

Some scholars Ball (1993:3) and Shulman (1986:7) confirm that teachers must possess supporting data and instructive information because content knowledge alone is not sufficient (refer to Section 2.4.4). Then the current study discovered that teachers were experiencing challenges during the teaching and learning of fractions, owing to lack of pedagogical content knowledge. They noticed that teachers were not sharing their ideas and experiences with one another during teaching and learning of common fractions, the teachers worked individually (refer to Section 2.4.4 and Section 4.2.4.2).

5.3.4.1 *Recommendations for PCK of common fractions.*

In responding to the above-mentioned challenges of insufficient pedagogical content knowledge, it is recommended that the teacher should possess enough PCK to identify and correct learners' mistakes in common fraction concepts (refer to Section 2.4.4). Pragmatic data support the recommendation that teachers should undergo professional development through workshops, seminars and other teacher empowering projects (refer to Section 4.3.4). Therefore this strategy assisted teachers to empower learners to work in collaboration and share ideas during teaching and learning of common fractions (Gillis & Jacks 2002:2).

5.3.4.2 *Recommended condition conducive for effective use of pedagogical content knowledge.*

The study also discovered that pedagogical content knowledge (PCK) is critical for effective teaching and learning of common fractions (refer to Section 4.4.4). The researcher revealed that without adequate PCK, teachers would not be able to teach common fractions effectively to learners. Marake (2013:27) argues that teachers with effective PCK seem to use learner's prior knowledge to bridge the gap between formal and informal knowledge.

5.4 POSSIBLE THREATS TO THE STRATEGY.

5.4.1 Findings on limited time allocated for teaching of common fractions.

The study discovered that limited time allocated during teaching and learning of fractions has become a threat, that leads to teachers teaching common fractions by using rules and procedures (refer to Section 4.5. 2.). This threat impedes learners from having a deep understanding of common fractions and exert pressure on finishing common fractions within a short period (see Section 4.4.1 and Section Section 2.4.4.1). It is clear that teachers are not keen to use practical demonstrations since they have limited time to plan and prepare

(see Section 2.4.4.1). The study also revealed that limited time lead to insufficient use of different modalities due to the time available for teaching (see Section 4.5.3)

5.4.2 Recommendations on limited time allocated for teaching of common fractions

The study recommends that extra classes should be organised to compensate for the restricted time due to the length of the periods. Extra time affords the teacher with an opportunity to start and finish an activity so that an activity can develop as it was intended to for the learners.

5.4.3 Findings on teaching common fractions abstractly

Some teachers teach common fractions abstractly, which limits the opportunity for learners to discover things for themselves (refer to Section 1.2). This is common when teachers teach fractions using only rules and procedures. The work of Adendorff and Moodley (2014:424) reveal that teachers view practical demonstrations as time-consuming, citing time constraints as an excuse for not conducting them, (see Section 2.4.4.2). That is why the teachers end up using procedural understanding rather than a conceptual understanding of common fractions.

5.4.4 Recommendations on teaching common fractions abstractly

For the common fraction concepts to be understood by the learners, the teacher should try to concretise the teaching and learning of common fractions in order to assist learners in gaining a deeper conceptual understanding before a procedural understanding. This can be successful if learners can use tangible materials, such as manipulatives and other representation to make it meaningful to learners (refer to Section 4.3.2). The teacher uses concretisation to simplify abstraction of common fractions further. .

5.4.5 Findings on inappropriate staffing

Inappropriate staffing was discovered to be one of the threats. If teachers are given a subject that they are not familiar with and expected to deliver outstanding results, lack of content knowledge will be a threat where teachers were given mathematics, in particular, common fractions to teach, even if they did not specialise in it (see Section 4.5.4). National Academy Press (2001:428) expresses a similar view that the knowledge required in teaching mathematics, in particular common fractions, is specialised knowledge. To overcome these threatening factors to the framework, a context-based approach must be used in the teaching

and learning of common fractions in Grade 7. Correct staffing must be in place, for teachers to teach a subject that they can excel in. In addition, professional development programs should be in place to improve teachers' comprehension of fractions and how to teach them (Siegler *et al.* 2010:1).

5.4.5.1 Recommendations on inappropriate staffing

The recommendation from the study is that appropriate staffing should be done. This means teachers should teach subjects within their specialisation. Teachers who have specialised in mathematics have adequate pedagogical content knowledge. PCK assist the teacher in knowing the conceptions that learners hold on common fraction concepts. The knowledge of learners' conceptions helps teachers to tailor and diversify the teaching strategies in a way that can match different learners' learning styles.

5.5 LIMITATIONS OF THE STUDY

The limitation of the study is that it was conducted using one primary school in the urban area of Amajuba District in Kwa-Zulu Natal Province. The study was conducted to find and provide detailed data on teaching and learning of common fractions using a context-based approach. It can be noted that the study, by using a context-based approach to teach common fractions, sought to link learners' context to the content and deepen learners' conceptual understanding with procedural fluency in common fraction concepts. It empowered teachers to teach common fraction concepts more successfully.

On the other hand, the teacher can use sharing activities, where learners can share by using concrete objects like apples to concretise the lesson (Fazio & Siegler 2011:8). Demonstrating how many $\frac{1}{8}s$ are there in one apple, which is one whole. Learners are supposed to cut the apple into eight equal parts. Furthermore, fraction strips can be used to demonstrate how common fractions can be divided. For instance, showing how many $\frac{1}{6}s$ are there in $\frac{1}{3}$ of a fraction strip can assist the teacher in demonstrating the division of common fractions. Thus, learners can be able to discover for themselves how many $\frac{1}{6}s$ are there in $\frac{1}{3}$. The study was anticipated to assist learners in understanding that common fractions are used in their everyday real-life situations.

5.6 SUMMARY OF THE CONTEXT-BASED STRATEGY IN TEACHING AND LEARNING OF COMMON FRACTIONS IN GRADE SEVEN

5.6.1 Findings on the under-usage of modalities.

The team agreed that under usage of teaching modalities could be one of the threats in the teaching and learning of common fractions (see Section 4.5.3). Insufficient time allocation was observed as a threat to using teaching modalities for the framework to improve implementation of the context-based strategy during the teaching and learning of common fractions. This threat results in teachers not accommodating diverse learners in their class during the teaching and learning of common fractions. Sufficient time allocation was needed to ensure that teachers plan and prepare for the teaching and learning of common fractions for them to be able to accommodate the different types of learners that are in the class and so circumvent the threat.

5.6.1.1 *Recommendations on under-usage of modalities*

When modalities are correctly used during teaching and learning of common fractions, the teaching and learning of common fractions can be effective, which results in enhancing the teaching and learning of common fractions. This was evident when different types of learners were successfully accommodated by using different learning styles (refer to Section 4.3.3). According to Rogers (2012:4), during the teaching and learning of common fractions, teachers must make sure that they accommodate the different types of learners that are in the class. Hence diverse learners have different learning styles in which learners make sense of common fractions (refer to Section 2.4.2.3). Yassin and Almasri (2015:26) confirm that this was because different learners have different contexts; therefore, the teacher needs to use different teaching strategies to accommodate diverse learners' learning styles. This is possible when the teacher uses manipulatives and other demonstrations for the learners to gain a deeper understanding of common fraction concepts.

This study aimed to develop the strategy of teaching and learning of common fractions in Grade 7 using a context-based approach. To improve the understanding of common fractions among learners, the teacher must use more activities based on learning-by-doing activities like sharing activities. Furthermore, a pre-knowledge of the learners play an important role in the teaching and learning of common fractions because of their rich knowledge based on the experience accumulated from their social interaction. Furthermore, for the learning of common fractions to be successful, the teachers must start by using learners context for

teaching common fractions by starting with concrete objects and moving to abstract objects. This can be done through contextualisation by using learners' contexts.

5.6.2 Developing a framework to teach common fractions using a context-based approach.

Different challenges associated with learners' poor understanding of common fraction concepts were identified. These included calculations related to common fractions, teaching and learning modalities, addition and subtraction of common fractions and teachers' lack of PCK. The study discovered that learners had the problem in doing calculations that involved common fractions. It emerged during the study that learners were influenced by the whole number concepts. As a result, they used the same methods to calculate fractions. This was reflected when learners were supposed to add, subtract or even multiply common fractions. Learners add, subtract and even multiply numerators together and denominators together as if they were dealing with whole numbers. These activities by learners were associated with the teachers emphasising the memorisation of rules and procedures related to the concepts at the expense of a conceptual understanding. This approach does not accommodate different teaching and learning modalities that benefit different learners. This approach was associated with the deficiency in teachers' pedagogical content knowledge.

The framework was designed to respond to the challenges identified and to introduce the learners to the context-based approach to the teaching and learning of common fraction concepts. The framework acknowledges the role of learners' contexts in understanding common fraction concepts and trying to use concrete objects to contextualise the teaching and learning of these concepts. This was done through the use of paper strips, fraction walls, partitioning and iterating. Different teaching and learning modalities were also used to accommodate the different ways in which learners make sense of common fraction concepts. In order to use different teaching strategies to accommodate different learners, teachers needed to possess adequate PCK. This made it necessary for the framework to enhance the teachers' PCK through workshops and other teacher empowerment activities.

5.6.3 Conditions for the framework to teach common fractions using a context-based approach.

Some conditions were necessary for the implementation of the strategy. An appropriate approach that caters for different learners in the teaching and learning of common fraction concepts was one of the conditions conducive for the framework to work. This creates a

condition in a classroom where learners' social background is taken into account. This condition made it conducive for the learners to work collaboratively and have control of their learning without the teacher dominating the teaching and learning process.

5.6.4 Threats to the framework to teach common fractions using a context based approach.

Risks factors that are involved can threaten the framework and how they could be alleviated are discussed in this section. The time factor was identified as one of the risks factors that might upset the framework. A lot of time is required to use teaching and learning modalities in the classroom especially because some need to be handled by the learners themselves. This might result in disorder in the classroom.

5.6.5 Evidence of the success of the framework to teach common fractions using a context based approach.

This section discusses an indication of success in the implementation of the strategy. This is an indication that the strategy for teaching common fractions using the context based approach is successful. When the teachers use this approach, this approach enables the learners to develop a deeper understanding of common fraction concepts. If the teacher is using the context-based approach, learners content and the context are linked and assists learners to make sense of these concepts.

5.7 CONCLUSION

The study was directed to formulate a framework for using a context-based strategy to teach common fraction concepts in Grade 7 mathematics class. The framework obviously encouraged learners to be active participants during teaching and learning of common fractions. The research participants, especially parents, confirmed that the teaching and learning of common fractions do not end in the classrooms, as even in their context, they assisted learners to enjoy sharing which involved fairness that is involved in common fraction concepts. The knowledge that has been sidelined, but which is very rich in mathematical content, assisted parents to play a significant role in the teaching and learning of common fraction concepts. They further helped in concretisation where learners and teachers worked together using material at hand to concretise common fractions. It was evident when struggling learners succeeded in mastering common fraction concepts.

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7 APPENDICES

7.1 APPENDIX A: CONSENT TO PARTICIPATE IN THE STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read and understand the study as explained in the information sheet. I have had sufficient opportunity to ask questions and prepared to participate in the study. I understand that my participation is voluntary and that I am free to withdraw at any time. I am aware that findings of this study will be anonymously processed into a research report, and /or conference proceedings.

I agree to recording of the audio recording.

I have received a signed copy of the informed consent agreement.

Full Name of participant.....

Signature of participant.....Date.....

Full name of Researcher..... Date

Signature of Researcher.....Date.....

7.2 APPENDIX B: ETHICS CERTIFICATE



Faculty of Education

10-Jun-2018

Dear Mrs Queenhy Nyembe

Ethics Clearance: **The context based in teaching and learning of common fractions in grade seven**

Principal Investigator: **Mrs Queenhy Nyembe**

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

APPLICATION APPROVED

With reference to your 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-HSD2017/0455**

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



7.3 APPENDIX C: INSTITUTIONAL PERMISSION

PERMISSION LETTER

Request for permission to conduct research at

.....

The context based in teaching and learning of common fractions in grade seven.

12/ 03/ 17

Name.....

Building.....

Department of education.....

Telephone number.....

Email address.....

Dear

I, Queenlhy Ritta Lamlile Nyembe. Iam doing research supervised by Dr. Moloji T , in the Department of education towards an M E d at the university of the Free States. I am requesting permission to conduct research in your institution. The title of the study is, The context based in teaching and learning of common fraction in grade seven.

7.4 APPENDIX D: PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS



education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma

Tel: 033 392 1063

Ref.:24/8/1583

Ms QR Nyembe
PO Box 12379
Newcastle
2940

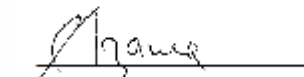
Dear Ms Nyembe

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"THE CONTEXT- BASED IN TEACHING AND LEARNING OF COMMON FRACTIONS"**, 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 30 July 2018 to 02 January 2021.
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 Phindile Duma 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.

(PLEASE SEE LIST OF SCHOOLS ATTACHED)


Dr. EV Nzama
Head of Department: Education
Date: 01 August 2018

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 1063 • Fax.: +27 033 392 1203 • Email: Phindile.Duma@kzndoe.gov.za • Web: www.kzmeducation.gov.za

Facebook: KZNDOE.....Twitter: @DBE_KZN.....Instagram: [kzn_education](https://www.instagram.com/kzn_education).....Youtube:kzndoe

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

7.5 APPENDIX E: LANGUAGE EDITOR'S LETTER



Member South African Translators' Institute
www.language-services.online

PO Box 3172
Lyttelton South
0176
30 July 2020

TO WHOM IT MAY CONCERN

The thesis titled "The context-based in teaching and learning of common fractions in grade seven" by Queenhy Rita Lamlile Nyembe has been proofread and edited for language by me. I verify that it is ready for publication or public viewing in respect of language and style and it has been formatted as per the prescribed style of the relevant institution.

Please note that no view is expressed in respect of the subject-specific technical contents of the document or changes made after the date of this letter.

Kind regards

A handwritten signature in red ink that reads "Anna M de Wet". The signature is written in a cursive, flowing style.

Anna M de Wet

BA (Afrikaans, English, Classical Languages) (Cum Laude), University of Pretoria.
BA Hons ((Latin) (Cum Laude), University of Pretoria.
BA Hons (Psychology), University of Pretoria.

7.6 APPENDIX F: TURNITIN REPORT SUMMARY

The context-based in teaching and learning of common fractions in grade seven

ORIGINALITY REPORT

% 12	% 9	% 3	% 7
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of Queensland Student Paper	% 2
2	scholar.ufs.ac.za:8080 Internet Source	% 2
3	scholar.ufs.ac.za Internet Source	% 1
4	uir.unisa.ac.za Internet Source	<% 1
5	Submitted to University of the Free State Student Paper	<% 1
6	Roslinda Rosli, Dianne Goldsby, Mary Margaret Capraro. "Using Manipulatives in Solving and Posing Mathematical Problems", Creative Education, 2015 Publication	<% 1
7	repository.up.ac.za Internet Source	<% 1

files.eric.ed.gov



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PO Box 3172
Lyttelton South
0176
17 November 2020

TO WHOM IT MAY CONCERN

The thesis titled "The context-based in teaching and learning of common fractions in grade seven" by Queenhy Rita Lamile Nyembe has been proofread and edited for language by me.

I verify that it is ready for publication or public viewing in respect of language and style and it has been formatted as per the prescribed style of the relevant institution.

Please note that no view is expressed in respect of the subject-specific technical contents of the document or changes made after the date of this letter.

Kind regards

Anna M de Wet

BA (Afrikaans, English, Classical Languages) (Cum Laude), University of Pretoria.
BA Hons ((Latin) (Cum Laude), University of Pretoria.
BA Hons (Psychology), University of Pretoria.