PROMOTING CRITICAL THINKING SKILLS IN FOUNDATION PHASE MATHEMATICS

BY

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DECLARATION

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DEDICATION

I dedicate this dissertation to my parents, husband and son.

To my parents, Mr. Logesh Kunniah and Mrs. Kogie Kunniah, without your love and support, I would not be the woman I am today. You have made many sacrifices in order to give me the opportunity to be an educated and independent individual and for that, I owe every success I have to you.

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ABSTRACT

The foundation phase in South Africa is seen as the early years of education, where key skills are established and begin to develop. With this perspective in mind, this study proposed to understand the promotion of critical thinking skills in foundation phase mathematics. The site of the study was a public primary school in Durban, Kwazulu-Natal, and three foundation phase mathematics teachers were selected using convenience and purposive sampling, from grade one, two and three respectively. The study was conceptualised within an interpretive paradigm, applying qualitative research through narrative inquiry. The study aimed to elicit data from participants by using reflective journaling to express their experiences in relation to promotion of critical thinking skills within their mathematics lessons. The data generated from the reflective journals, were analysed using Thematic-Narrative Analysis. The narrative reflections analysis was guided by the key objectives of the study, to explore and understand, the current situation of promoting critical thinking skills in foundation phase mathematics, how this promotion is achieved and why it is enacted in the ways that it is. Three themes were derived, revealing that teachers are aware of critical thinking skills as a prerequisite of the Curriculum and Assessment Policy Statement and perceive these skills as an asset for learners. However, teachers integrate critical thinking skills, as a secondary component in lessons due to limited timeframes, vast amounts of curriculum and lack of adequate teaching training. Additionally, it was found that despite these challenges, teachers are using multifaceted teaching approaches and learning techniques to promote critical thinking skills and often take on the role of facilitator to aid this promotion, in their foundation phase mathematics lessons. Furthermore, findings showed that teachers understand that there are many long-term benefits attached to the promotion of critical thinking skills, such as creating individuals who are prone to inclusive thinking, skilled communicators, independent thinkers, providing learners with an overall improved quality of life. Hence the study finds that the promotion of critical thinking skills is underway within the foundation phase mathematics lessons. However, to counteract teacher challenges, the study recommends that teachers, receive regular training on critical thinking development to ensure the promotion of critical thinking skills are integrated efficiently into lessons. Timeframes allocated to mathematics subject curriculum, should be reviewed, taking into account teachers' perspectives and learner needs, with consideration for critical thinking development in curriculum teaching and learning. Further, assessment regimes need re-evaluation, to differ assessment according to learner capabilities.

KEYWORDS: Critical thinking, Critical thinking skills, Foundation Phase, Mathematics

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LIST OF ABBREVIATIONS AND ACROYNYMS

BT	Bloom's Taxonomy
CAPS	Curriculum and Assessment Policy Statement
CT	Critical Thinking
CTS	Critical Thinking Skills
DBE	Department of Basic Education
FP	Foundation Phase
KZN	KwaZulu-Natal
NA	Narrative Analysis
RBT	Revised Bloom's Taxonomy
RJ	Reflective Journals
SCT	Social Cognitive Theory
SCTCD	Socio-Cultural Theory of Cognitive Development
TA	Thematic Analysis
TNA	Thematic Narrative Analysis
UKZN	University of KwaZulu-Natal
ZPD	Zone of Proximal Development

CHAPTER ONE: INTRODUCTORY BACKGROUND

1.1 INTRODUCTION

Schools in South Africa continuously work collaboratively with government education authorities to redress inequalities of the past, and a strong focus has been on implementation of emancipatory approaches to teaching and learning (Mokoena, 2019). The aim has been to improve the quality of education, so that teaching and learning is aligned with the needs of the local and global economies. The implication of this restructuring in education, shows a need for learners to have critical thinking skills in order to draw associations between their educational learning experiences and local and international needs and concerns (Garcer, 2018). Learners who are taught to be critically aware and to engage in critical thinking (CT), excel at mathematics and have a distinct advantage over children with no experience of this discipline (Sanders, 2016). A significant number of learners have many difficulties in dealing with mathematics (Lefkowitz, 2019), especially since the priority is deliverance of curriculum content as opposed to customization of delivery to enhance suitability for learners. This often leads to abhorrence of critical thinking skills (CTS) in the educational outcomes. However, in many primary schools across South Africa teachers are developing critical thinking skills in mathematics as a foundation for future success (Pols, 2019). A positive point made by many teachers is a show of their commitment to and love of education. They believe fully that the dire situation and lack of CTS can be addressed and rectified (Maddock & Maroun, 2018). It is from this positivity and enthusiasm, that this study draws for the promotion of learners' CTS by teachers in foundation phase (FP) mathematics.

1.2 BACKGROUND OF THE STUDY

According to the South African Constitution (Act 108 of 1996) and the South African Education Policy Statement (2019), every citizen of the country has the right to be numerate (Department of Basic Education, 2018). In order to address this right, early introduction of mathematics, as a core subject, has been implemented in the foundation phase (FP) (Jojo, 2019). Mathematics is not about answers but about the thinking processes which take place in order to understand numeric computations (Jameel & Ali, 2016; Kristianti, Prabawanto, & Suhendra, 2017). Thinking is defined as a process of consideration or reasoning, in order to form an opinion or idea: or in psychology it involves the production of thoughts using the mind (Charlton, 2019; Alban, 2018; Gelb, 2018). It is a skill that is required in all aspects of life and is made up of different types of thinking, such as creative thinking, abstract thinking

and analytical thinking (Mcclung, 2017). However, within the realms of thinking lies, Critical Thinking (CT) that is a higher order skill which is a multifaceted practice of alternative views, open-mindedness and consideration which encompasses a wide range of skills, such as identifying the position people take in arguments, evaluating evidence of arguments, weighing up the possible opposing arguments, reflecting upon different issues that may create concern, deriving adequate conclusions, synthesising information and establishing and demonstrating personal perspectives (Cottrell, 2017; Mcpeck, 2016; Ohlson de Fine, 2015).

CT appears to be at the end of the list in skills to be achieved by learners and is often reserved only for the best performing learners (Seale, 2017). In many FP classrooms, in South Africa, priority is given to the coverage of curriculum content and cognitive skills, whilst Critical Thinking Skills (CTS), are addressed only after the curriculum has been covered (Mabaso, 2017; Garcer, 2018). Many teachers complain of insufficient time to complete national mathematics curriculum plans and ultimately there is little - no time left for the development of CTS (Maddock & Maroun, 2018). The inclination of teachers is then to prioritize content and to wait until the end of curriculum coverage to request learners to reflect critically on ideas. Thus, even when learners' CTS is addressed in classrooms, it is often separated from the curriculum, and predominantly taught as a nonspecific skill that learners are expected to apply to their education and to everyday life, but they are expected to perform and develop this skill on their own. Putting it frankly, learners' CTS are often overlooked or disregarded in many FP mathematics classrooms (Carton, 2019).

1.3 RATIONALE FOR THE STUDY

Personally, CTS have been a central focal point in my education from an early age. They were instilled in me by my parents who taught me always to question any given discussion or teaching to create a better understanding. Similarly, I was taught to give a good solid justification for the choices I had made and would make in the future. This encouraged a rationale of thinking within myself to analyse any teaching or situation in a strategic manner and to evaluate my options in response. This type of skill to think critically, continued to be promoted in my early education. In primary school mathematics, I found myself constantly challenged by the notions presented by my teachers, to find deeper meaning and understanding in lessons. Most lessons consisted of information being presented but entailed a need for the application of individual CTS, to discover how, what and why the answers were represented

as they were. This process continued in my secondary school education. My mathematics teacher strived to create learners who could 'think beyond the page'. My mind had truly been challenged to new heights during these mathematics lessons. However, it would have felt almost an impossible task, had there not been a foundation for the development of my critical thinking skills during my early schooling years, to lay the groundwork for what I needed to do in order to find an understanding of the true depths of mathematics.

As a grade two mathematics teacher, I constantly find myself wary of how I teach and conscious of the need to find new ways of teaching mathematics to my learners, to develop and improve their CTS. I usually find learners who may understand repeated addition but, cannot use strategic selection and application of the concept, when questioned in a word problem, as compared to number-based sentences. I find this a similar scenario, when the concepts of measurement are discussed. Measurement is often understood better when physical objects are included, but learners find difficulty in an application of measurement concepts when asked questions based on drawings. It can therefore not be said that learners do not understand these mathematical concepts, but that they are unable to apply CT competently, to solve mathematical problems efficiently. Many mathematic lessons result in learners giving up on the attempt to find solutions to mathematical problems, if they feel the answers may not be as clear and as straight-forward to achieve as they expected. Fellow foundation phase mathematics teachers at my school, share similar views about CTS lacking in our learners. Thus, to address this constraining behaviour in mathematics, CTS need to be developed and embraced.

According to recent articles (Ngozo and Mtantato, 2018; Garcer, 2018) published in South Africa, critical thinking skills are in great demand. A more serious finding to be noted, is that almost 25 per cent of learners who are present in the schooling system in grade 1, do not complete their primary education until grade 12 (Carroll, 2018; Mokoena, 2019). This dropout rate has been closely linked to learners performing poorly in mathematics and the poor performance in mathematics subsequently was found to be the result of a lack of CTS, as learners need to be able to think quickly and decisively, and have a certain set of skills to question or debate mathematical problems (Jameel & Ali, 2016; Jojo, 2019).

A wide-spread issue amongst South African learners, is that they are below the suggested curriculum goal level for Mathematics comprehension, especially those in the FP who are performing well under par (Province of Eastern Cape Education, 2013). About 50 per cent of South African learners exiting the FP are still unable to perform basic

calculations, such as dividing 24 by three (Ngozo & Mtantato, 2018). Learners in the FP are exposed to basic addition and subtraction facts, and even multiplication tables, however, the issue identified is how they actually learn these concepts. Teaching of mathematics is usually done via rote methods and this emphasises memorisation instead of teaching for analysing and understanding (Lefkowitz, 2019). FP mathematics is then taught as if it were mere recipes, integrating limited growth of thinking and reasoning. Learners may therefore lack CTS, such as decoding in mathematics (Mcpeck, 2016). FP mathematics, provides the building blocks for number sense and the critical thinking skills which promote development of mathematic concepts. Inherited deficits in this phase can grow over time to the extent that they become overwhelming for the learner and increase possibilities of learners finding difficulties in mathematics in higher grades (Dlamini, 2018; Jameel & Ali, 2016).

In South Africa if children are to be successful in mathematics at higher levels of education then emphasis must be placed on the building of necessary CTS in the FP, where the groundwork is laid for further building and development of these skills (Chikiwa & Schafer, 2018). A serious ramification of non-implementation of CTS development in the FP, is that it may prove to be a difficult problem to rectify later on for learners (Garcer, 2018). Despite the fact that it is at this stage in life in which evaluation should occur, CTS are at an alarmingly low level in SA, and interventions to promote the development of such skills should be addressed as early as possible in the learners' education (Kruger, 2016; Kronenberg, 2019). Taking into account the reasoning provided by the three dimensional approaches, which are the personal, professional and contextual factors, this study will explore the promotion of CTS in FP mathematics.

1.4 STATEMENT OF THE PROBLEM

From my understanding, previous studies have speculated on the promotion and relevance of developing CTS in education, however little emphasis has been put on the promotion of learners' CTS in FP mathematics, specifically within the South African context. Literature shows an emphasis on the development of CTS being put forward predominantly in secondary schools and in university level education, especially in the English language curriculum (Rahman & Manaf, 2017; Soozandehfar & Adeli, 2016). The limited research into CTS in FP mathematics in SA, represents a gap which is addressed in this study. There is a necessity to explore the promotion of CTS in FP mathematics, as the FP represents the phase in which foundations for further development are laid. This study is therefore intended to explore

the early promotion of learners' CTS and how and why teachers choose to promote it in this way.

1.5 PURPOSE AND OBJECTIVES OF THE STUDY

1.5.1 Purpose

This study proposes to explore and understand the promotion of CTS in FP mathematics using the reflections of FP mathematics teachers. Although the primary focus of the study is on reflections from the teachers, the insights generated can create awareness and allow for further recognition of learners' CTS in FP mathematics by all major stakeholders, such as school management teams, administrators and learners. An awareness of CTS created within the school, can contribute to teachers reflecting on their teaching styles and to them re-evaluating their lesson planning. These reflections can illicit consideration of the consequences, the teachers' practices and deepened understandings can have on learners, and thus promote the positive inclusion of CTS development in classrooms. It is further anticipated that this study may provide an expansion of knowledge and understanding for future research and policy makers, withregard to CTS in FP mathematics.

1.5.2 Objectives

The objectives outlined for this study, are stated as:

- To explore the current situation regarding the promotion of CTS in FP mathematics;
- To understand how CTS are promoted in FP mathematics; and
- To explore why CTS are being promoted the way that they are in FP mathematics.

1.6 CRITICAL RESEARCH QUESTIONS

Parallel to the objectives outlined for this study, the following research questions were designed to address the promotion of CTS in FP mathematics:

- What is the current situation regarding the promotion of learners' CTS, by teachers in FP mathematics?
- How is this promotion of learners' CTS being enacted in the teaching of FP mathematics by teachers?
- Why are learners' CTS in FP mathematics being promoted by teachers, the way that they are?

1.7 DEFINITIONS OF TERMS AND CONCEPTS

For the intended purposes of this study, the key terms will be defined as follows to promote better understanding, and will be used consistently throughout the study:

1.7.1 Promotion

In this study, promotion refers to the encouragement and help offered by teachers to learners to increase development of skills and learning (Merriam-Webster, 2020) . Promotion, therefore denotes motivation and activities provided by teachers which stimulate, support and contribute to the progression of learners' cognitive development, specifically relating to Critical thinking skills (*Cambridge International Dictionary of English,* 2020; *Oxford Advanced Learner's Dictionary of Current English,* 2020).

1.7.2 Critical thinking skills

Critical Thinking (CT) is a cognitive process which is used to acquire knowledge (Cottrell , 2017; Paul & Elder, 2019). Within this process a set of skills required to achieve the desired knowledge. These skills act as a set of tools which allow you to create a better understanding and a holistic view of a situation using all available information and facts (Doyle, 2019; Schmaltz, Jansen, & Wenckowski, 2017). Critical Thinking Skills provide a means to use an organized and systematic method to identify a problem, and to develop effective solutions, while being able to justify how and why you have come to such a conclusion (Gormley, 2017; Wade, 2016).

1.7.3 Foundation phase

Within the South African schooling and education sectors, the FP refers to the first stage of formal schooling and establishes a basis for learners to grow within the formal schooling system (Sayed & Mcdonald, 2017). The focus of this phase is to provide fundamental learning techniques and to introduce ethical behaviour and manners (Basel, 2016). It is made up of Grades R, 1, 2 and 3 (Department of Basic Education, 2011). However, in this study, I will be concentrating on grades 1, 2 and 3 only.

1.7.4 Mathematics

Mathematics can be described as the discipline of numbers and their operations, interrelationships, combinations, and abstractions of their structure (Jameel & Ali, 2016; Stinson, 2018), measurement, transformations, and generalizations (Chigonga, 2017; Garcer, 2018). Moreover, mathematics is defined as a systemically organized science which is exact in nature, specializing in the concepts of quantity, measurement and spatial relations (Sophia, 2018). It involves the production of assumptions and properties when dealing with numbers (Russell, 2020). Although mathematics can be segmented into different categories, such as pure mathematics, applied mathematics and calculus (Russell, 2020; Sophia, 2018), this study focuses on pure mathematics only: mathematics which is concerned with increasing knowledge of number relationships (Yadav, 2017; Bozkurt, 2017).

1.8 THE SIGNIFICANCE OF THE STUDY

The study of the promotion of learners' CTS in FP mathematics, explores a crucial component of the most valued thinking in the world. The study has the potential to create an awareness of providing learners in the FP mathematics classrooms, with the indispensable thinking skills to deal with an ever-changing world. This study therefore can promote cognizance of a healthy and supportive education climate in which progressive teaching and learning can occur. It provides an expansion of the existing literature to create encouragement of learning critical thinking skills from early introduction in the educational sector, which can be used for future research and policy makers.

Further, an awareness of learners' CTS is created within the school site, encouraging participating teachers to reflect on their teaching styles and to re-evaluate their lesson planning. These reflections can illicit appreciation of the consequences of the teacher's practices and a deepened understanding of the consequences this can have on learners, and thus promote the positive inclusion of critical thinking skills development in classrooms. Subsequently, once learners are able to adapt to change in thought and to develop skills to be critical thinkers, they will not rely on blatant absorption of information but will be able to question and build knowledge on their own accord by drawing on their CTS.

1.9 OVERVIEW OF RESEARCH DESIGN AND METHODOLOGY

1.9.1 Qualitative research approach

This research study was guided by a qualitative inquiry approach. Qualitative studies endeavour to study a focus area in a holistic manner in order to assess its complexity and to ensure that their inferences take account of both distinctive and universal factors (Crossman, 2019). Qualitative research, attempts to understand issues from the perspectives of the participants, discovering the underlying meanings and interpretations that participants associate with their behaviour, attitudes, events or processes (Hennink, Hutter, & Bailey, 2020). This type of research enables an exploration of such developments; and allows for the multiple truths and realities to be uncovered (Rahman, 2017).

Qualitative research, simply has no ending but rather only questions, in order to pursue a truthful reflection which reverberates with the responses of the participants in the study (Cresswell & Poth, 2018). It consequently, provides a medium for research to be tolerant, inquiring, compassionate and flexible, in order to listen to the stories participants, share and thereby to derive information (Eisner, 2017). The building of rapport in qualitative research can thus be created due to the comfortable atmosphere that should prevail (Hennink, Hutter, & Bailey, 2020).

As an inductive process, qualitative research builds hypotheses, concepts and theories from details (Borrero, 2018; Pham, 2018). It can consequently draw understanding from the subjective meanings which participants attach to their views and experiences, as well as from that of the researcher's own frame of reference on the issues being studied (Brent, 2018). Dual understanding is vital, since human behaviour cannot be understood without understanding the framework in which its subjects interpret the world, and qualitative researchers acknowledge their influence and interaction in the study they are conducting (Crossman, 2019).

Overall, qualitative research provides a means to view existing data in new ways (Goldstein, 2017). Studies are done on a small scale and rather than rigorously defining the observations. They provide an account which considers both unique and general factors (Hammarburg, Kirkman, & de Lacey, 2016). Qualitative research approaches chiefly rely on the researcher as the means for data generation and analysis, to achieve this holistic view (Moser & Korstjens, 2017).

Consequently, qualitative research was selected as the best suited approach for this study. This approach provided an avenue for me to gain in-depth understanding of participating FP teachers' experiences and thoughts, when promoting learners' CTS in mathematics. The qualitative approach applied, allowed for teachers to be comfortable and to be forthcoming with information and thus reflections were detailed and meaningful. Further, the Qualitative approach, allowed for the simplifying of data for easy management without altering the complexity of it.

1.9.2 Research paradigm

For research to have a distinct path of inquiry, researchers require a direction, a foundation of understanding, and a focused viewpoint of the world in which the research will take place. In order to achieve this, we rely on a paradigm. A paradigm is, a direction or plan for research with an intended focus and can also be viewed as an elementary belief system with a theoretical framework for assumptions (Rehman & Alharthi, 2016). This should include a specific collection of notions that form an outline or model. In particular, these ideas must collaboratively reflect a worldview supporting a certain subject or pursuit (Kumar, 2019; Ling & Ling, 2017). Therefore, paradigms can be viewed as a frame of reference which researchers use to organize and reason the methodological characteristics of their chosen research, in order to identify the applicable research methods to be used and how the data collected will be analysed (Hennink, Hutter, & Bailey, 2020; Kivunja & Kuyini, 2017).

Within the realm of paradigms, is the interpretive paradigm which is characterised by outcomes which are constructed in a social context (Ling & Ling, 2017; Kumar, 2019). Reality is identified as multidimensional, in which numerous truths exist, however, it presupposes that reality is socially constructed in all instances (O'Donoghue, 2019). Since human behaviour is significantly influenced by the environmental setting in which it occurs, research must take into account the multitude of contextual factors such as schedules, adopted notions of norms, customs, roles, traditions and values (Hammarburg, Kirkman, & de Lacey, 2016).

The interpretive paradigm, epitomizes understanding. A relativist ontology is revised to understand a phenomenon, it's multiple truths and therefore the several interpretations that are available (Pham, 2018). All efforts are made to attempt to understand the views of the participants fully rather than focusing on the views of the researcher (Kumar, 2019).

The interpretive paradigm was selected for this study, as the context of this research lies in education. Education shares similar views that reality and truths are established in a social context. Teaching and learning in education, provide truths that can be regarded as the building up and breaking down of personal and social constructions, between teachers and learners (Kim, 2016). Hence an intrepretive paradigm is beneficial in educational studies and the most applicable for this study.

1.9.3 Research design

1.9.3.1 Narrative inquiry as a research methodology

Methodology refers to the critical analysis of data production techniques (Mukherjee, 2020), and guides the researcher in deciding what the suitable data generation tools for the particular research are (Rehman & Alharthi, 2016). This research study will apply a narrative inquiry methodology which is in line with the qualitative approach and the interpretive paradigm. Narrative inquiry, by nature is approachable, offers an artistic quality, is not overly dogmatic and values the stories of people (O'Grady, Clandinin, & O'Toole, 2018). We make understandings of our own lives through narratives we live out and share. It is therefore an appropriate way to indulge in the actions of others vicariously. Narrative inquiry provides a framework from which explorations into human experiences in the world can be drawn (Haydon, Browne, & van der Riet, 2018). Rich descriptions of significant issues are identified via the stories shared by people. The use of stories to understand, helps to create meaning of human experiences, to explore the implications of life events, and the complexities involved in peoples' actions. It pays attention to the feelings, views and values of people we aim to understand (O'Grady, Clandinin, & O'Toole, 2018; Kim, 2016).

Arguably one of the most suitable ways of understanding multifaceted and complex experiences, Narrative inquiry, focuses on the lived experiences of people (Spires, 2017; Clandinin, 2016). It provides a holistic view of a phenomenon from the views, experience and stories of people who have been exposed to it. Narratives produced, are therefore interpretations which are drawn from personal, cultural and historical contexts, and these contexts ensure that these stories do exist in an isolated reality (James, 2018). Narrative inquiry is an insightful and useful data generation tool (Hellman, 2018). It is capable of creating a complex depiction of the phenomenon focused on in a study (Golombek & Johnson, 2017; James, 2018), and this can be achieved by exploring the subjective meanings behind

experiences from the retelling of stories. Emphasis is then on understanding how people frame their thoughts and recall these in order to report them in the form of narratives. The narratives are thus valuable sources of knowledge about experiences (Clandinin, 2016). Consequently, the acts of recall and retelling of stories, can in itself create awareness and promote change, either personally or socially, or even in both domains (Visser, Du Preez, & Simmonds, 2019).

Since education is social in nature, narrative inquiry represents a way of ordering these interactions or experiences into stories of both individual and social events, and subsequently into the production of knowledge in educational contexts is often unquestioned, and narrative inquiry enables the silence to be broken by the intimate involvement of stakeholders (O'Grady, Clandinin, & O'Toole, 2018). Therefore, it can be said that narrative inquiry is founded on practical ideas about educational experiences in the form of recalled and communicated stories (Kim, 2016; Clandinin, Cave, & Berendonk, 2017). Thereupon, Narrative inquiry was selected as an appropriate methodology to address the promotion of learners' CTS in FP mathematics, in this study.

1.10 DATA GENERATION METHODS

1.10.1 Reflective journals

As Narrative inquiry had been selected as the methodology for this study, selected data generation methods had to be found to provide a means to narrate participants' experiences. For this, I relied on Reflective Journals (RJ) that are written entries for reflection of either good or bad experiences (Clandinin, 2016). It provides an outlet necessary to acknowledge and understand experiences of the past and to use this knowledge to work on one's present self (Moses, 2019). By reflecting through committing thoughts and reflections to writing in the journals, an awareness of one's own thoughts, feelings and positions arise encouraging different levels of metacognition: the awareness of one's own thinking processes (Bashan & Holsbat, 2017; Thropp, 2017). Being reflective in journaling, provides an opportunity for participants to disengage and to write freely about experiences. When writing freely, negative thoughts can be easier to share as opposed to sharing via verbal dialogue. Revisiting the RJs, can therefore present openings to acknowledge the negativity and to validate it as an experience which can enable one to take away the potential lessons it may offer and then move forward to positivity (Clandinin, Cave, & Berendonk, 2017; Goldstein, 2017).

As a data generation method, RJs, are practical and provide easy utilization through structure and format (Göker, 2016). They are multi-dimensional and can take on many different forms, for ease of understanding by participants and can also encourage the sharing of narratives (Bashan & Holsblat, 2017). RJs are also lenient on time constraints, leaving participants in positions of control. Time restrictions have the potential to impede participants' ability to recall experiences or to share their truths accurately (Rodriguez, 2017), so by eliminating this, participants can be more relaxed and comfortable to share knowledge at their own pace.

The RJ was therefore applied as the primary source for data generation/production in this study. In the education sector, the use of reflective journals is a way of discovering and framing truths. It allows for participants to move through their narratives and to go back to them when necessary, allowing for time to think about responses, take notes and make amendments to what they want to share (Rodriguez, 2017; Thropp, 2017). The reflective nature of these journals encourages participants to express their current understanding of learners' CTS, and to verbalize new ways of thinking and doing, in order to project what could be done in an imagined future (Golombek & Johnson, 2017). This expression and verbalization allow for a consideration of the consequences of teachers' teaching practices on their learners. The reflective process supports the emergence of new findings which result from increased control over participants thoughts and actions, yielding meaningful experiences and this allows teachers to be more aware and thoughtful about their work (Goldstein, 2017; Bashan & Holsblat, 2017). The essential goal of using RJs is to develop a better understanding of a phenomenon and this may involve challenging participants to access their truths, to think about them and to come to understand them (Göker, 2016; Thropp, 2017). The journals can therefore awaken the consciousness and provide meaningful insights into experiences (Rodriguez, 2017), hence the RJ was the most apt data generation tool for this study.

1.11 SELECTION OF PARTICIPANTS

To sample in qualitative research, is to apply a technique to systematically select a relatively small group of individuals or items from a pre-defined population to be observed in order to explore and understand a phenomenon as per the objectives of the study (Hoeber, Hoeber, Snelgrove, & Wood, 2017; Sharma, 2017). For this study, I administered the non-probability sampling technique of purposive sampling.

Purposive sampling offers versatility in the selection of cases that can provide rich and specific information related to a phenomenon (Etikan, Musa, & Alkassim, 2016). The researcher deliberately selects participants who are well-informed and proficient in dealing with the phenomenon being studied, and are willing to share knowledge by virtue of their experiences (Taherdoost, 2016). This selection of participants is done by identifying specific constituencies, and evaluating the specific characteristics and assets of individuals who are capable of addressing the core research questions of the study (Valerio, Rodriguez, Winkler, Lopez, Dennison, Liang & Turner, 2016). Purposive sampling is the ideal choice for researchers who have limited physical resources, limited time and who do not aim to generalize the findings (Serra, Psaara, & O'Brien, 2018; Ferreira, Rabelo, Vieira, Pereira, & Andrade, 2018).

Additionally, criteria for inclusion and exclusion of participants were implemented, prior to the actual selection process. By employing these criteria, the researcher defines who can be included and excluded from the study. The criteria assist the researcher by framing the participant appropriateness, reducing possible withdrawals from the study and guides selection so that objectives of the study can be achieved (Garg, 2016; Patino & Ferreira, 2018). To address the inclusion and exclusion criteria for this study, the following was applied: Inclusion of participants was based on their current teaching subject at the research site school. Specific inclusion criteria were that all participants should have been teaching the subject of mathematics in the FP for a period of 1 year or more, and only teachers who demonstrated a willingness to participate in the research would be considered. The exclusion criteria used for this study, were that all non-mathematics teachers would be ineligible for the study, and the teachers who did in fact teach mathematics in FP but had limited availability to participate in data generation process, would be omitted.

Using the purposive sampling technique and the inclusion and exclusion criteria, participants for this study were selected. As determined by myself as the researcher, 3 FP mathematics teachers from one public school in the province of Kwazulu-Natal (KZN), within the eThekwini, Mafukuzela Gandhi district were identified as participants. One teacher from each grade was identified for this study to represent. grades 1, 2 and 3, respectively. The number selected was manageable and provided a representation of each grade and in this way a holistic perspective of FP mathematics. The selection of teachers was deliberate in order to address the objectives and research questions outlined for this study and to characterize the context for inquiry (Butler, Copnell, & Hall, 2018). Participating teachers had been in the profession of mathematics teaching ranging from 10 to 20 years of service.

1.12 DATA ANALYSIS

Thematic Narrative Analysis (TNA) was the chosen method for data analysis in this study. According to Evans (2018), thematic analysis provides a means to explore, the impact experiences have on the lives of individuals, and the ways in which these experiences are socially constructed by them. Parallel to this, themes identified permit the researcher to study how these themes reveal the 'reality' of participants' lived experiences, the physical or societal settings in which they live and which either pressure, enable or restrict their prospects for the promotion of CTS (Xu & Zammit, 2020). Complimentary to the thematic analysis component, is the narrative analysis, which explores the primary narrative elements of each theme identified, and interprets them through the narrative accounts to show methodical attention to what is being articulated by the participants (Olusoga & Kentta, 2017; Bengtsson & Andersen, 2020; Ronkainen, Watkins, & Ryba, 2016) Accordingly, the use of TNA should be applied when probing into the ways that people generate meaning and significance out of their experiences, as well as how they not only build their social worlds through this meaning making, but also want to preserve a focus on the ways in which these experiences will be affected by their physical experiences and frameworks (Belotto, 2018; Taylor, Henshall, Kenyon, Litchfield, & Greenfield, 2018). .

Guided by this form of analysis, data generated from the RJs will be reviewed repeatedly to screen all information. This will allow for a deeper understanding to be created and a general sense of codes and later themes to be generated (Andrews, 2019). The next guided step will be to find key points or themes related to the promotion of learners' CTS, and to systematically group information gathered from the RJs into the identified themes. The themes will thereafter be reviewed through a narrative analysis, with the allocation of statements and descriptions from the RJs, under specific themes. Quotes, excerpts and narrative accounts from participant's transcripts will also be used to examine how the themes identified help to structure the personal experiences of participants (Hoff, Lobo, Knudson-Martin, & Distelberg, 2018).

1.13 ETHICAL CONSIDERATIONS

Prior to the commencement of this research study, a written application was submitted to the Department of Basic Education (DBE) requesting permission to conduct this study in one of its schools (see Appendix A). Ethical clearance to conduct this study was obtained from the University of KwaZulu-Natal, Ethics

Committee (see Appendix B). Permission was also requested from the principal of the school in which the study was to be conducted. Confirmation of approval will be provided in written documentation from all stakeholders as appendices A, B and C.

An informed consent form designed for all participants stipulated the aims, methods and use of data from this study. Each participant was given ample time to read and complete these forms (see Appendix C). Opportunities were also granted for any queries from participants regarding the study to be addressed. Participants were further advised in the consent forms of their voluntary participation in the study and of their right to resign from the study at any given point, should they wish to do so. Furthermore, the consent forms explicitly declared that there would be confidentiality observed and anonymity for participants as pseudonyms would be used for the records.

1.14 THE TRUSTWORTHINESS OF THE STUDY

Qualitative research can be regarded as a true-to-life approach, seeking to understand phenomena in settings which are content-specific and it aims to provide illumination. Consistency, plausibility and integrity in qualitative research is created through objectivity, credibility, transferability and trustworthiness of the research (Perakyla, 2016; Hammarburg, Kirkman, & de Lacey, 2016). However, qualitative researchers are now embracing their immersion and role within the research process, and are now being accepted as legitimate agents in research (Rahman, 2017). So, it can be said that the objectivity, credibility, transferability, and trustworthiness depend on the ability and efforts of the researcher (Sharma, 2017). Consistency, plausibility and integrity are factors which any qualitative researcher should be concerned about in designing a study, analysing results and in judging the quality of the study. Complimentary to consistency, plausibility and integrity, is the term ‘rigour’, which ensures that the research was directed in a systematic manner and to a high standard (Moser & Korstjens, 2017; Taylor, Henshall, Kenyon, Litchfield, & Greenfield, 2018).

This study endeavoured to meet these standards by providing careful records, demonstrating a clear trail in the research and ensuring that the different interpretations gathered from data were represented accurately and with transparency. Comparisons which were drawn, highlighted similarities and differences in perspectives from participants, and these verbatim accounts were used to support the research findings. Additionally, participants were invited to comment on the final transcripts and provide an evaluation of the final themes identified, to ensure that they

were a true reflection of the phenomenon which was being researched (Belotto, 2018; Perakyla, 2016). The research ultimately attempted to give an unbiased and true reflection of the experiences and views of teachers (Dudovskiy, 2019)

1.15 OVERVIEW OF THE CHAPTERS

Within this chapter I provided an outline of the study as a whole.

Chapter 2 - provides the theoretical framework that guides the analysis of this study.

Chapter 3 - presents the literature review established for this study, and explores the issues and concerns related to the promotion of CTS in FP mathematics.

Chapter 4 - conveys the selected research design, methodology and, procedures and processes that were applied to the generation of data. Moreover, the chapter entails descriptions of the data generation instrument, describing the selection of participants elected, and declares the process used for data analysis.

Chapter 5 - examines the data generated from participants' narrative reflections in reflective journals and provides an analysis of the data, according to the themes and sub-themes that were identified in the participants' reflections. Interpretations of this data and its subsequent findings will be offered.

Chapter 6 - offers a holistic summary of the study, presenting the conclusions of findings, resultant implications, acknowledged limitations of the study, and ultimately concludes the study.

1.16 CHAPTER SUMMARY

In summary this introductory chapter, articulated the background, the problem statement, and the rationale for this study. Further the significance of the study was suggested, in relation to the contribution it could make to improving the quality of education. Additionally, the objectives and questions to be addressed in the study were detailed, together with the methodological approaches selected to achieve them, as well as the identification of the contextual setting and participant selection. In the next chapter, I will describe the theoretical framework chosen for this study.

CHAPTER TWO: THEORECTICAL FRAMEWORK

2.1 INTRODUCTION

In the previous chapter, an introduction to the study was provided. The background and rationale for the study was discussed, also including the problem statement, research questions, definitions used in this study and the research methodology applied. Additionally, I introduced the significance of the study and the considerations incorporated to attend to the trustworthiness and ethical aspects of this research. This chapter will therefore progressively discuss the theoretical framework that I applied to this study. The theoretical framework of a study explains the direction of the research and establishes it in theoretical constructs (Adom, Hussein, & Agyem, 2018). It distinguishes the particular perspective taken by the researcher and highlights the key concepts of theories employed to guide the research study (Lempriere, 2019). The aim of the theoretical framework is to make findings from the study, more meaningful and acceptable in terms of the identified theoretical constructs (Rudasill, Snyder, Levinson, & Adelson, 2018). This study is focused on understanding and exploring the promotion of learners' CTS in FP mathematics, based on teachers' experiences, with the aim of generating awareness among teachers and recognition of CTS in FP mathematics by all education stakeholders. It may therefore provide an expansion of knowledge for future research and education advancements. The theories used for this study were selected, as the most theoretically suitable to understand CTS in FP mathematics, and therefore the theoretical framework is built upon Benjamin Bloom's, Bloom's Taxonomy (1956) and is supported by Lev Vygotsky's Socio-Cultural Theory of Cognitive Development (1978) and Albert Bandura's Social Cognitive Theory (1961), both of which fall under the heading Social Constructivism. Henceforth, in this chapter, I have discussed each of the aforementioned theories, by drawing on each of their coherent aspects in order to establish the unified theoretical framework that supported this study.

2.2 THE ORIGINS AND EVOLUTION OF BLOOM'S TAXONOMY

In the year, 1948 at the convention of the American Psychological Association, a group of experts on assessment and college examiners, made a group decision that it would be advantageous to execute assessments of student performance in America, if educational goals could be classified (Preville, 2018). These academics then formed a committee, chaired by University of Chicago's professor, Benjamin Bloom (1913-1999). Thereafter the committee reconvened following every American Psychological Association convention, to collaboratively construct and improve their classification system (Bloom, Engelhart, Furst,

Hill, & Krathwohl, 1956).

At the very beginning of their committee meetings, the focus was on facilitating the exchange of test items which measured the same educational measures (Forehand, 2017). However, this process led to a natural linkage of verbs associated with different levels of learning (Soozandehfar & Adeli, 2016). Thereupon, the introduction of the taxonomy of educational objectives, was then launched and in 1956, Benjamin Bloom with collaborators Max Englehart, Edward Furst, Walter Hill, and David Krathwohl published this framework for categorizing educational goals under the title: *Taxonomy of Educational Objectives* which became more widely recognized as *Bloom's Taxonomy* (BT) (Armstrong, 2016). Within this publication was a triangular diagram depicting the vertical movements made, with the progression of educational attainment goals, rising through six different orders of learning (Nkhoma, Lam, Richardson, Kam, & Lau, 2016; Preville, 2018). BT was identified as one of the first systematic classification systems to be applied to processes of thinking and learning (Forehand, 2017). In the years that followed it became recognized as a valuable tool for ranking the relative difficulty of innumerable educational objectives.

In the present day, more than 60 years after its first introduction, BT is still influential in education. BT is based on the premise of creating cognitively alert thinkers rather than those who simply recall information (Bloom, 1956), proceeding from simple functions to those which are more complex (Wilson, 2016). The taxonomy is internationally recognized, is often used as an aid when designing questions for tests, discussions and assignments (Deller, 2019) and is known to develop and strengthen cognitive abilities (Benjelloun & El Kirat El Allame, 2019); and overall shape the content and delivery of education globally (Preville, 2018).

2.3 BLOOM'S TAXONOMY

BT was designed to provide specific objectives in education. These objectives were classified within three domains, namely Cognitive, Affective and Psychomotor (Krathwohl, 2002). Each domain offered different objectives, such as:

Cognitive Domain – This encompasses the known (intellectual aspect) and the methods of processing gathered information, knowledge and attitude skills, such as knowing, understanding and skills for thinking (Voskoglou, 2019; Retno, Arfatin, & Nur, 2018). The primary focus within this domain are the intellectual abilities such as the use of concrete operations like identification of facts and application of theoretical skills to produce new

additions or original work, and is also closely linked to the development of CTS (Gorman, 2018; Busch, 2017).

Affective Domain – This entails the accentuating of the different facets of feeling and emotion, such as interest, approach, intention, gratitude, recognition, eagerness, zeal, motivation, often related to notions of taste, like or dislike, care or not care (Sisson & George, 2019). It infers the way people respond to others emotionally and their awareness of empathic reflections (Krathwohl, Bloom, & Masia, 1964). Thus, an overview of the affective domain shows emphasis on internalizing values and organization of attached emotions (Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Rath & Wittrock, 2001).

Psychomotor Domain – This is concerned with behaviour with an emphasis on motor skills such as handwriting, drawing and sport. Central to the domain is the human capacity for physical ability and the ability of an individual to control the utilisation of their own body structures (Retno, Arfatin, & Nur, 2018; Mahmud, Yaacob, Ramachandiran, & Ismail, 2019). When applied to the classroom environment, activities will have learners move around and there will be limited sitting time, and such learner engagement encourages the making of long-term memories, which are conducive for learning (Gorman, 2018).

2.3.1 The Cognitive domain

As mentioned above, BT entails three domains which categorize learning objectives applied in education. Therefore, the learning outcomes often have an impact on the quality of cognitive, affective and psychomotor skills among learners. However, it is the Cognitive domain, which is widely recognised as a framework from which educational objectives, testing and curriculum outcomes are designed (Deller, 2019; Retno, Arfatin, & Nur, 2018).

By design, the cognitive domain predominantly focuses on intellectual abilities and differentiates thinking into six cognitive levels of complexity (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). As a taxonomy, the levels are arranged in a hierarchical order where the learner is meant to advance from the simplest to the complex with prerequisite skills or knowledge at the first level of the hierarchy (Gorman, 2018). Each level must be mastered before commenced movement to the next level. For this reason, BT is often represented as a pyramid, with the six levels and movement starting from level 1, at the bottom moving up towards level 6, at the apex. The levels of this pyramid are identified as follows:

Knowledge- This constitutes the memory recollection and demonstration of prior learning

through the expression of fundamental and basic concept questions. This may relate to knowledge of specific terminology, facts, processes, patterns, methodologies, and structures which are universally accepted (Mahmud, Yaacob, Ramachandiran, & Ismail, 2019; Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956).

Comprehension- This level focuses on the skill to paraphrase the acquired knowledge content in their own words, the classifying of different objects into groups by drawing comparisons and identifying contrasting items with other parallel objects (Rahman & Manaf, 2017). It may therefore refer to the understanding of material, such that the learner knows what is being transferred and can refer to the material or idea being communicated when required to do so. (Armstrong, 2016)

Application- This level indicates the skills learners should be able to use, so they may take knowledge and understanding and relate these to certain situations (Deller, 2019). It implies that learners can identify the required concepts or thoughts and be competent to relate this knowledge to actual situations (Gorman, 2018).

Analysis- This encompasses the prospect of learners' drawings relationships between different ideas or being able to identify the smaller components of the learning and to articulate these components into correlated groups while inferring specific elements or principles (Sisson & George, 2019; Retno, Arfatin, & Nur, 2018).

Synthesis-In this level information and knowledge is gathered via different means of approaches to form new ideas or structures (Mahmud, Yaacob, Ramachandiran, & Ismail, 2019). This implies an identification of similar or co-related data sets being intentionally drawn together to create a full and meaningful idea, with clarity and precision (Rahman & Manaf, 2017).

Evaluation- This is the level in which learners are expected to make judgments or objectively to offer critical appraisal of the validity and relevance of the methods or materials presented to them or used by themselves based on a specific set of criteria (Deller, 2019; Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956).

BT has been implemented internally since its inception in 1956, in multitudes of educational facilities and structures. However, it was found to be one dimensional in the way it viewed the learning processes and was thus revised in 2001.

2.4 REVISED BLOOM'S TAXONOMY

In 2001 a revision of BT was published by a group of cognitive psychologists, curriculum theorists, instructional researchers, and testing and assessment specialists, all led by Lorin Anderson and David Krathwohl. The revised BT was titled *A Taxonomy for Teaching, Learning, and Assessment* (Anderson, et al., 2001). The title of this publication drew attention away from the one-dimensional or static notion of 'educational objectives' initially outlined in BT and projected a more dynamic notion of classification (Armstrong, 2016). This illuminated their goal of meaningful learning, which they define as learning that promotes retention and transfer (Krathwohl, 2002).

The Revised Bloom's Taxonomy (RBT), focused on the cognitive domain, which maintained a central component based on thinking, and since thinking occurred through different forms and thinking is an active process, the RBT opted for the names of its six major levels to be changed from noun to verb forms (Voskoglou, 2019). The implementation of verbs, suggested that action was required in the cognitive processes by which learners encounter and work with knowledge (Soozandehfar & Adeli, 2016). RBT also incorporated student-centred learning prototypes into the 1956 BT, which was meant to improve learners' comprehension of and to hold learners responsible for their own learning, cognition, and thinking (Nkhoma, Lam, Richardson, Kam, & Lau, 2016).

The RBT was designed to be dynamic and active, and thereby an accompanying innovative movement was made to break the cognitive domain into two dimensions: process and knowledge (Krathwohl, 2002). The cognitive process dimension still consisted of six levels listed from lowest to highest in the form of a pyramid, but were classified as: remember, understand, apply, analyse, evaluate, and create. It was noted that the last three levels of the RBT pyramid, is characterized by skills which engage in critical thinking and thus aids in the promotion of CTS (Brennan, 2017). The complimentary second dimension of the cognitive domain which is concerned with the types of knowledge or the different ways of knowing (Wilson, 2016) which makes the RBT more relevant to the skills required in the 21st century (Darwazeh, 2016).

2.5 LEVELS OF THE REVISED BLOOM'S TAXONOMY

The RBT followed the pyramid placement of six levels, however renaming each level with

verbs and gerunds to describe the cognitive processes that learners are required to use (Deller, 2019), moving from the most concrete forms of thinking to abstract (Gorman, 2018). A verb in this sense describes the expected cognitive process, and noun describes the knowledge that teachers expect students to acquire or construct (Wang, 2018). This leads to figure 2.1.

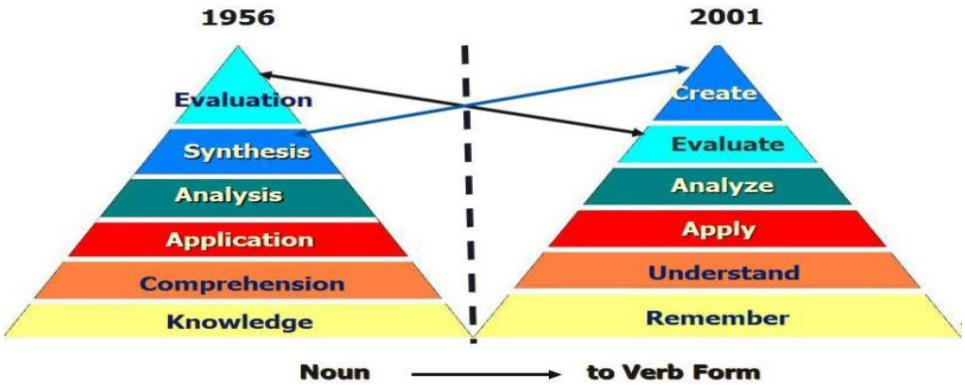


Figure 2.1: Comparison of the original BT (1956) in relation to the RBT (2001)

Source: (Wilson, 2020, p. 4)

Drawing comparisons from the original BT and the RBT as depicted in figure 2.1 above, the notable changes are that, the knowledge level of the original Taxonomy was renamed as remembering, while the comprehension level of the original Taxonomy was renamed as understanding. There were no changes to the application and analysis levels of Bloom's Taxonomy that were preserved in their original positions. As a final point, the synthesis level was renamed to create, and the order of the create level was interchanged with evaluation in the Revised Taxonomy. Hence the RBT, identifies remember, understand and apply as lower-order thinking processes and the analysis, evaluation and create as higher-order thinking skills. Further an overall change from the original BT cognitive levels and the new RBT cognitive levels, was a fluidity between levels, allowing for overlapping (Krathwohl, 2002).

2.5.1 Remembering

Remembering, the initial process in RBT, is the essential cognitive process skill because it involves the use of recognition or recall to recover knowledge from long-term memory (Gorman, 2018). Hence, the most suitable action verbs, such as 'recognizing', and 'recalling' give learners direction, that the learning required is a basic lower order thinking skill (Sweet, Blythe, & Carpenter, 2016), informing a need for recognizing or recalling knowledge from memory when addressing the question presented. Learners are usually asked simple questions when required to remember or recall information or knowledge about specific content

(Benjelloun & El Kirat El Allame, 2019). In a mathematics lesson, this may entail asking learners to identify names of shapes or numbers. In other words, remembering refers to tapping in to memory to retrieve descriptions, facts, procedures, definitions or lists; to narrate or paraphrase knowledge which was learned in prior lessons (Anderson, et al., 2001; Voskoglou, 2019). In effect, a positive learning environment will encourage the preservation of the information and it acknowledges the importance of information retention (Prismana, Kusmayadi, & Pramudya, 2018). Recall or remembering of information is parallel to the rate of learning that can occur and the extent to which the learner can grasp and learn from new information presented (Soozandehfar & Adeli, 2016; Deller, 2019). The rate at which learned knowledge is retained, also correlates with the duration in which learners can store the learned knowledge and by encouraging knowledge to be grouped into schemes of similar characteristics, information can be retrieved more easily from long-term memory (Ugur, 2019).

2.5.2 Understanding

Understanding refers to the transferring of information in the brain to different grounds, so that the learner can engage the information and process this to undertake specific operations (Wilson, 2016). During this process, the information stored in the long-term and short-term memory, are stimulated based on the information required and to be processed (Ugur, 2019). Learning at this level is often associated with actions such as interpreting, exemplifying, classifying, summarizing, inferring, comparing and explaining (Deller, 2019). It may entail the construction of meaning via different means such as through writing or graphic messages or even activities which encourage interpreting, exemplifying, classifying, summarizing, inferring, comparing, or explaining (Anderson, et al., 2001). For a learner to exhibit an understanding of a learned concept he or she must demonstrate ways in which they can make sense out of the knowledge or to identify the specific content and discuss it, in their own words (Wang, 2018). Learners can be asked questions such as, how to find the main idea of the word problem, or to identify the correct numeric operation required or to explain the number patterns and their consequence (Gorman, 2018). The answers to these questions reveal the learners' understanding of the learned content and still presents an opportunity for them to develop their own ideas (Benjelloun & El Kirat El Allame, 2019). Thus, understanding can be identified by the building of meaning from the uses and inferences of learned terms, facts, approaches, processes, or concepts (Voskoglou, 2019).

2.5.3 Application

Application is the highest level of the lower-order thinking skills and is described as having either correct or incorrect answers (Deller, 2019). This particular cognitive processing skill level necessitates that learners carry out or use a technique in a situation by using learned knowledge. If teachers ask learners to implement or perform an activity, learners would be displaying skills at this level of thinking (Sweet, Blythe, & Carpenter, 2016). Therefore, if a learner can select, transfer, and use data and principles to execute a task with a minimum of direction or supervision, they can be showing competence in the applied skill (Gorman, 2018). Applying may consequently relate to or refer to situations where learned content is demonstrated through products like building of models, performing presentations, or in simulations (Anderson, et al., 2001). Theoretically applying in this level, learners should be able to apply prior knowledge from lessons to new situations which can also help learners to develop their own thoughts and ideas in a way which is more critical (Benjelloun & El Kirat El Allame, 2019). In mathematics this may refer to the application of practiced theory, or problem-solving and the use of information in new mathematical concepts or themes (Voskoglou, 2019). Hence it involves executing a process related to the information learned from lessons, by accessing long-term memory through remembering, because the information on how to perform this process is stored in this memory (Ugur, 2019).

2.5.4 Analysis

In the RBT, analyse is considered the lowest level of the higher-order thinking skills. At this level, learners are often asked to differentiate, organize or distinguish facts, data and subject matter from a set of information (Kurtulus & Ada, 2017). Hence, this level would require the learner to demonstrate self-reasoning, critical thinking, problem-solving or to think creatively, and if the learner can successfully perform the thinking skills required, it signifies that positive and meaningful learning has taken place (Gorman, 2018). Consequently, in the analysing level, mental actions such as discriminating between the components or parts is needed. By breaking down and determining relationships between one component and another, drawing comparisons between parts or how the parts connect to a structure or purpose learners show competence in analysing (Voskoglou, 2019). In mathematics, learners can also illustrate capability in this level by incorporating mixed data into charts, or diagrams, or graphs (Anderson, et al., 2001). In addition, this level encourages the learners to examine the

information and to start thinking about other alternatives in order to process such information (Benjelloun & El Kirat El Allame, 2019). Learners may then look at mathematical problems and provide assumptions and to identify logical relevancy (Retno, Arfatin, & Nur, 2018). The analyse level is characterized by mental processes like, distinguishing and organizing

2.5.5 Evaluation

Evaluate was moved from the top of Bloom's original taxonomy and placed on the second highest level in the revised version (Anderson & Krathwohl, 2001). This level deals with the making of judgments based on specific criteria or standards (Gorman, 2018). Decision-making is required by the learner to evaluate successfully, so that he or she must make decisions based on a process of reflection, critical awareness and assessment (Rahayu, 2018). By checking, critiquing, providing recommendations, and submitting reports learners show positive products, that can be produced to establish the methods of evaluation (Deller, 2019). At this level in mathematics, children start evaluating the processes of answering problems, giving their opinions and justifying them without right or wrong answers, and accepting that others may have different opinions (Kurtulus & Ada, 2017). Given ample opportunities, even weaker learners can show the ability to answer such questions suitably and resourcefully if there is ample time given to reflect on their thoughts (Benjelloun & El Kirat El Allame, 2019). Overall, analyse involves judgment and appraisal in learning and in RBT evaluating is an essential step before learners can create something (Anderson, et al., 2001).

2.5.6 Creation

In the RBT creating something original or significantly new is considered to be the highest level of thinking (Anderson, et al., 2001). Often verbs such as generate, plan or produce guides learners in their learning and work requirements (Deller, 2019). The peak of thinking processes within the RBT is the ability to create, which involves combining or aligning different elements in order to produce an articulated whole, as well as to take different components and to reorganize them into new patterns or structures (Armstrong, 2016; Nkhoma, Lam, Richardson, Kam, & Lau, 2016). In this process, the learner invents, assimilates, and draws associations between ideas to make a product which is new to him or her (Wilson, 2016). This process is the most difficult mental function in the new taxonomy (Anderson, et al., 2001). This level can help the learners to use their prior knowledge and skills to create their own story that makes sense to them and to the world around them. This level can be the end product for learners after reading

a story because it allows them to demonstrate clearly the accurate use of appropriate vocabulary that helps them to link their ideas in a more logical, critical, and creative way (Benjelloun & El Kirat El Allame, 2019). In mathematics learners can put things together; bring together various parts; write about a specific theme or concept, present a holistic speech on concepts by putting information together in a new & creative way (Voskoglou, 2019). This may entail learners building a house using different shaped blocks, and using their knowledge of shapes, sizes, weight and dimensions.

2.6 DIMENSIONS OF KNOWLEDGE

Identified as the second dimension of the cognitive domain, Knowledge was also a differentiated development in the RBT. This addition emphasizes how the RBT traverses and acts upon different types and levels of knowledge, such as factual, conceptual, procedural and the metacognitive. It is important to note that the first three of these levels were in fact identified in the original work BT, but were rarely discussed or introduced when primarily discussing uses for BT, and part of the revision was to address these three levels of knowledge and to provide an additional level of the metacognition (Wilson, 2016).

Factual - Factual knowledge is declarative and is generally accepted as fact. It can therefore often be taught and learned via rote using rote-like methods (Nkhoma, Lam, Richardson, Kam, & Lau, 2016). Factual knowledge can therefore entail the basic elements of a topic (Gorman, 2018). This knowledge is fundamental for learning in specific disciplines, for example in mathematics, counting on with numbers or identifying specific number order. The dimensional view of factual knowledge refers to essential facts, terminology, details or elements learners must know or should be familiar with, in order to understand a subject, concept or to solve the problem in question (Anderson, et al., 2001). It can therefore be identified as the foundational aspect of knowledge acquisition (Wilson, 2016).

Conceptual - Conceptual knowledge is about the explanatory aptitude and the ability to summarize large ideas or thoughts and their smaller parts (Nkhoma, Lam, Richardson, Kam, & Lau, 2016). It may consequently include the knowledge of classification and categorization, the knowledge of principles and generalizability, also looping with knowledge of philosophies and theories (Gorman, 2018). Conceptual knowledge can then be characterized by the

understanding of interrelationships among the basic elements of a larger whole that enable them to function together and in unison, and being able to explain such phenomena (Wilson, 2016). In mathematics, problem- solving gives priority to conceptual knowledge in relation to the basic concepts required in completing a task, such as determining specific numeric operations and being aware of how they will affect numbers (addition will increase numbers and subtraction will decrease a number) (Prismana, Kusmayadi, & Pramudya, 2018).

Procedural - Procedural knowledge is concerned with how to do or complete a specific task or activity which may include knowledge specific skills for certain subjects and procedures, techniques and methods, and knowledge of principles or criteria for determining when to apply the most apt procedures (Gorman, 2018). In mathematics, learners will need to demonstrate an application for the use of methods of inquiry, and criteria for using techniques when solving problems (Wilson, 2016). This may refer to the correction application of different numeric operations and understanding which order the operations should be applied in, especially when more than one operation is required to solve the problem (Voskoglou, 2019). Hence in mathematics, procedural knowledge gives priority to the process related to the methods and approaches in problem- solving (Prismana, Kusmayadi, & Pramudya, 2018)

Metacognitive - Metacognitive knowledge is concerned with the awareness of one's own thought processes (Ugur, 2019). This may include strategic knowledge, knowledge about cognitive tasks which can further involve the appropriate contextual and conditional knowledge and self-knowledge (Gorman, 2018; Anderson, et al., 2001). This knowledge allows learners to be alert to their ideas and thoughts, in particular the cognitive processes that occur and therefore become more critical in their thinking (Rahman & Manaf, 2017). It is often strategic in application and it often requires learners to be reflective with their knowledge, in order to guide them through the solving of problems, cognitive tasks and to strengthen their own contextual and conditional knowledge and knowledge of self (Rahayu, 2018; Wang, 2018).

2.7 AIMS AND OBJECTIVES OF BLOOMS TAXONOMY

RBT is focused on the cognitive development of learners, and is aimed at creating opportunities for active engagement in learning that fosters motivation, independence and critical thinking (Anderson, et al., 2001; Deller, 2019). The classification system as a whole is designed to provide teachers with a framework in which to view the curriculum and how the intended outcomes of the curriculum can be achieved through the strategic application of specific learning activities and assessments that fit into each level for learners, so that learners can acquire new knowledge and skills (Preville, 2018; Retno, Arfatin, & Nur, 2018). RBT therefore

aims to guide teachers on the how, what, when and why dynamics of teaching and learning (Krathwohl, 2002).

Hence the general objectives of the RBT can be identified as, acknowledging the learning outcomes at the outset (Armstrong, 2016), in order to understand and establish the most applicable pedagogical interchange so that both teachers and learners understand the purpose of their interactions (Darwazeh, 2016; Sweet, Blythe, & Carpenter, 2016). Also, teachers can benefit from using RBT to organize objectives according to levels of difficulty, because organizing objectives helps to clarify goals for themselves and for learners and also forms part of plan, so that foundations can be laid in order to construct new skills and knowledge (Soozandehfar & Adeli, 2016; Patil & Gaurshettiwar, 2016). Moreover, having a framework that provides an organized set of objectives is beneficial to teachers when preparing lesson plans, so that appropriate instructions can be designed with suitable strategies and also the relevant assessments can be aligned with the designated objectives (Rahman & Manaf, 2017; Benjelloun & El Kirat El Allame, 2019).

2.8 SOCIAL CONSTRUCTIVISM

The ideology of Constructivism is often supported by the underlying philosophy and beliefs, that learners are able to construct their own meaning and knowledge through establishing interactions with their surrounding environment and this includes their interaction with other people via communication, collaboration and in the process of learning (Mahmud, Yaacob, Ramachandiran, & Ismail, 2019). Over the years, constructivism has gained recognition for its effectiveness in relation to educational settings that are associated with learners' performance (Panjwani, 2019). Constructivism presents a system which allows learners to indulge in an active role and encourages learner responsibility within the process of learning, as opposed to passively receiving information (Taylor, 2018). It can therefore place emphasis on discourse, reflection, experience and communication, among learners and also between the learners and teachers (Iba & Burgoyne, 2019).

However, the learning process is often multidimensional. Learners do not merely interact with learning resources, but also socially network with other people, such as teachers, fellow learners and the schooling community at large, which provides a wide variety of both social and individual features. This focus on social factors, introduces the ideology of social constructivism.

Social constructivism is a philosophy about the construction of knowledge and meaning,

through the development of interactions learners have with other people around them (Panjwani, 2019). According to social constructivists, all forms of knowledge are a construction, including those symbolizing both the physical and biological reality and truths about these realities, that are all intertwined with history and culture (Locklear, 2020). This philosophy, maintains that knowledge construction is contingent on the perceptions held by individuals about culture, history and context, and the effect of social interaction during the learning process (Taylor, 2018). The social constructivist learning process itself, is often building upon prior knowledge, and allowing learners to view this existing knowledge in new ways (Iba & Burgoyne, 2019). Thus the process of learning in social constructivism, revolves around the notions of social interactions leading the increased levels of competency in reasoning and understanding, and learners actively developing intellectual skills (Bozkurt, 2017).

2.8.1 Socio-Cultural Theory of Cognitive Development

One of the leading theorists in the social constructivist domain, is Lev Vygotsky who developed the Socio-Cultural Theory of Cognitive Development (SCTCD). According to Vygotsky:

> "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological), and then inside (intrapsychological). All the higher functions originate as actual relations between human individuals." (Vygotsky, 1978, p. 57).

Hence the theory is based on the premise that all learning occurs at two levels: firstly, through interaction with others and secondly, through a process of integration into the learner's own mental structures. The SCTCD can then be characterized by the belief, that cognitive development is a product of social process which begins at birth and is assisted by others who are more knowledgeable and competent in skills (Ormrod, 2017), and this form of guided learning is fostered through a collaboration with the learners Zone of Proximal Development (ZPD) (McLeod, 2018; Chetty, 2019).For this study, the focal points of SCTCD, will be on the four key processes of social interaction that stimulate development and learning, which are: ZPD, scaffolding, language, social and cultural tools:

ZPD - This zone is considered an area of exploration for which a learner is cognitively prepared to learn new skills, but still requires the help, guidance and social interaction to develop proficiently (Ormrod, 2017; McLeod, 2018). Therefore, it can be considered as a product created in the course of social interaction (Iba & Burgoyne, 2019). Vygotsky (1978, p. 86),

described the ZPD as:

> "the distance between the actual developmental level as determined through independent problem-solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers".

Consequently, the ZPD is identified as the difference between what a learner can accomplish independently and what he or she can achieve in conjunction with another person, who is considered an expert (Chetty, 2019). Furthermore, the potential a learner has for cognitive development is thought to be restricted to the ZPD, therefore the ZPD can give a clear indication of the interaction required for developing cognitive structures and the acquisition of social aptitudes or the lack thereof (Locklear, 2020).

Scaffolding - Scaffolding is the use of a variety of instructional techniques that are often used by teachers or more knowledgeable peers to provide individualized support or help to learners by incrementally improving a learner's ability to build on prior knowledge and to accomplish challenging tasks (Ardila, 2016; Vygotsky, 1987). Scaffolding can provide special types of benefit that can offer learners assistance to move towards the learning of new concepts and understandings, and to develop skills (Bozkurt, 2017; Zhang & Wang, 2018). Additionally, scaffolding presents opportunities for questions to be raised with learners in order to get them to think about tasks in different ways to increase productivity, allowing for frequent feedback and helping learners to develop plans when attempting to complete new tasks (Ormrod, 2017). It is often applied in the learning process to bridge gaps to address the variance between what is already learnt by learners and what they are potentially expected to have known and be capable of achieving at particular levels in their education (Chetty, 2019). Hence one of the main objectives of scaffolding is to minimize the negative reactions and self-perceptions attributed to learners who may experience frustration, intimidation, or discouragement when they endeavour to tackle difficult tasks without the support, guidance, or understanding they require to complete them (Vygotsky, 1978; McLeod, 2018).

Language – A central assumption supporting SCTCD is the fact that human mental activity is identified as a mediated process, in which symbolic and socio-culturally constructed products, the most substantial of which is language, play a vital role in the mental life of the learner (Vygotsky, 1978; Chetty, 2019). The concept of language is intrinsic in SCTCD, and implies that information is processed and stored and is closely followed by how the learner interprets the gained knowledge about themselves and their social environment (Locklear, 2020). The internalization of language is recognized as the main vehicle of thought and mediation for cognitive development (Shabani, 2016).

Learning is viewed as a socially mediated process, which is influenced first and foremost by different modes of semiotic tools, such as systems of counting; mnemonic procedures; arithmetical symbol systems; art works; writing; arrangements, diagrams, maps and mechanical drawings; all sorts of orthodox signs, the most important of which is language (Bozkurt, 2017; Zhang & Wang, 2018). Subsequently, the process of learning also includes mediation which initially starts off as social and then proceeds to being individualistic, in nature. SCTCD views language as the driving force behind this movement, because interaction between the learner and more experienced members in the environment, which may include parents, teachers, and peers, is predominantly done linguistically (Mulindi, Ogoma, & Wanami, 2019; Iba & Burgoyne, 2019). Moreover, language permits the transmission of knowledge and without language of either verbal or written formats, means the knowledge we have about the world will be limited by only immediate sensory information and tangible environmental circumstances, and thus escalates the likelihood of survival and endurance (Ormrod, 2017).

Social and cultural tools - SCTCD highlights social and cultural influences on the process of learning and claims that the social element of cognizance is first and foremost in time and in fact that the individual element of cognizance follows as a derivative (Vygotsky 1978). Vygotsky therefore stated that learners do not merely react to stimulants in a particular situation, but that all people develop their own cognition through a considered mental development process of appropriating higher forms of the psyche, which are generated by culture and passed on to the child during interaction with the adult (Iba & Burgoyne, 2019; Locklear, 2020). Hence the transfer of knowledge is not done passively.

The argument of SCTCD is that learning is contextual, implying that learners do not learn about facts and theories in isolation and in a framework detached from their lives, but rather learn in relation to what he or she already knows and believes, which would include the learners own predispositions and fears (Pathan, Memon, & Memon, 2018; McLeod, 2018). Therefore, learning is viewed as social and active (Shabani, 2016). SCTCD suggests that learners' understanding is moulded through interactions between different people in relation to the world because learning is closely connected with our associations and communications with other human beings such as the teachers and peers at school, family and associates (Mulindi, Ogoma, & Wanami, 2019). In an educational setting, socialization can influence mental constructs that learners use to construct knowledge and it evidently influences cognitive development. In this way the SCTCD places emphasis on contributions of social and cultural tools on cognitive development and recognizes that the uniqueness of social and cultural background settings, as influential factors for the development of advanced forms of human mental activity, such as

intentional attention, calculated memory, logical thought, preparation, arrangement and problem--solving (Zhang & Wang, 2018)

SCTCD embodies the notion that the environment a learner socializes in, not only acts as an influence but also as a source from which personal cognitive development can occur, and this development is stimulated by the environments' social and cultural factors (Vygotsky, 1987). Through language and scaffolding in the ZPD, learners can internalize and adopt new knowledge, skills and understanding, so that learning occurs via psychological instruments rather than through dependence on physical instruments (Veraksa & Veraksa, 2018).

In education the very idea of developing learning puts the knowledgeable other, such as the teacher or peer in a profoundly different position, and instead of being an external spectator and predictor of the learner's development, the knowledgeable other becomes a manager and developer of this process (Bozkurt, 2017; Pathan, Memon, & Memon, 2018). This learning is guided by teachers in the classroom who are the expert adults, by share meaning and mediating learning for young learners (Glatter, Deruy, & Wong, 2016). According to Vygotsky, by providing learners with these opportunities to participate in numerous groups and with partnered activities, this increases the potential internalization of influences of intellectual development and knowledge acquisition from collaborative work which is often guided by cultural and worldly aspects, if they are scaffold by more skilled and knowledgeable others (McLeod, 2018; Shabani, 2016; Ardila, 2016).

2.8.2 Social Cognitive Theory

In the early 1960's the Social Learning Theory was developed by Albert Bandura and was later modified into what we now know as the Social Cognitive Theory (SCT). The underlying principle of SCT, is that learning takes place in a social context and is accompanied by dynamic and reciprocal interaction between the learner, environment and behaviour (Vinney, 2019). SCT places an importance on social influences and the emphasis it has on both internal and external reinforcement from a social viewpoint, while attention is paid to how learners acquire and sustain behaviour, and how such behaviour is performed in a social environment (Dace, Stibe, & Timma, 2020; Gulsen, Erman, & Pinar, 2018). Therefore, SCT is an interpersonal theory focusing on mutual interactions, and proposing that both the environment and personal characteristics influence behaviour (Rolling & Hong, 2016)

A fundamental premise of SCT is that learners endeavour to achieve a sense of agency, or the

notion that they can exercise a significant degree of influence over particularly important experiences in their own lives (Schunk & DiBenedetto, 2020). Learners may then use this sense of agency by applying their cognitive and self-regulative competencies, to set goals and to employ strategies in attempts to achieve these goals (Bandura, 1986). Each learner will monitor their own progress toward reaching their individual goals and will make necessary adjustments to their strategies as they may see fit (Gulsen, Erman, & Pinar, 2018).

The SCT takes into consideration the past experiences of the learner which may have an impact on whether or not new behavioural action can take place and acknowledges that these past experiences have the potential to influence or to reinforce expectations, which affects whether or not the learner will employ new specific behaviour and be able or not to provide reasons for the employment of that particular behaviour (Dace, Stibe, & Timma, 2020; Pratap, 2018). SCT therefore argues that indirect learning happens when it emerges from the observation of behaviours of other people (Gulsen, Erman, & Pinar, 2018). This learning framework, can create opportunities for learner enablement, in order to learn the general and established learning structures without these being subjected to the process of trial and error (Brennan, 2017; Rolling & Hong, 2016). This may lead to a learner's observance of the modelling scenario, and the learner can embark on breaking down the negative prior knowledge, and on gaining new beliefs and values, while discovering new ways to learn how to make use of their surrounding environments from watching the model (Knowlden, Robbins, & Grandner, 2018; Shrestha, 2017).

Bandura describes knowledge as a foundation for behavioural change and such knowledge is gained in a social environment (Rolling & Hong, 2016). Hence, the SCT implies that the essential tenets of observation, imitation, and modelling, noting the reinforcements and consequences of learners' behaviour are associated with stimuli and symbolic interaction with others (Schunk & DiBenedetto, 2020; Bandura, 1989). It is for this reason, that the central theme of SCT is to explain how learners regulate their own behaviour through control and reinforcements in order to achieve their goals (Pratap, 2018).

As stated earlier, the SCT evolved from the original Social Learning Theory, and from both theories six constructs emerged as the foundational principles for Bandura's view of learning. These constructs are:

Reciprocal Determinism – This is often referred to as a central component of SCT. This emphasises the dynamic and reciprocal interaction of a learner who has his or her own set of past experienced in which they have learned from the environment which is considered an

external social context, and behaviour which is the actions or responses to stimuli, used to achieve goals (Bandura, 1989; Geerlings, Thijs, & Verkuyten, 2018). The causation elements of reciprocal determinism, does not mean that all the sources have the same strength of influence (Dace, Stibe, & Timma, 2020). Strength of each influence may differ and have an impact on the learner at separate intervals or simultaneously. However, regardless of the time required, each element does exert an influence and stimulates reciprocal determinism, even if it requires different amounts of time (Gulsen, Erman, & Pinar, 2018). Behaviour is therefore influenced by the environment, interactions, personal factors and cognitive processes of the individual learner (Locklear, 2020). These elements are continually acting upon each other and therefore the behaviour is said to be controlled or determined by the individual, through his or her cognitive processes and functions, and by the environment, through external social inducement (Cherry, 2018; Pratap, 2018).

Behavioural Capability – This denotes the learner's actual ability to perform a behaviour by applying essential knowledge and skills acquired (Bandura, 1986). It includes a representation of both proximal and distal actions which may be utilized to enact a particular behaviour (Cherry, 2018). Learners should be able to understand and have skills and knowledge, and should also be able to know the what and how aspects, in order to efficiently perform a behaviour (Brennan, 2017; Ross, Perkins, & Bodey, 2016). Therefore, behavioural capability also entails aspects of tools and resources that may be available to the learner in order to make new behaviour easier to perform (Kong, Deng, & Zhang, 2019).

Observational Learning – The premise of observational learning, states that a learner can be a spectator and observe a behaviour which is conducted by others, and thereafter the learner can reproduce the same or similar behaviour (Bandura, 1989). This is demonstrated through a process called modelling of behaviours (Locklear, 2020). If a learner can see efficacious enactments of a behaviour, there is the possibility that the learner can also perform the behaviour fruitfully (Knowlden, Robbins, & Grandner, 2018). However, modelling can have both negative or positive effects, depending on the behaviour being witnessed. Observational learning entails four basic conditions: 1) Attention: If a learner is going to learn any aspect from a modelled behaviour, then the learner must be paying full attention to the model and the behaviour being demonstrated (Gulsen, Erman, & Pinar, 2018; Shrestha, 2017). 2) Retention: The learner must also be able to remember the behaviour that was enacted and observed, so that such behaviour can be imitated at a later time (Brennan, 2017; Vinney, 2019). 3) Reproduction: This incorporates both the physical and mental ability of the learner to duplicate

the behaviour that was observed (Kong, Deng, & Zhang, 2019; Schunk & DiBenedetto, 2020). 4) Motivation: the learner must have a reason for imitating the behaviour, and if there is no reason then regardless of positive attention, retention, or reproduction being accomplished, no new behaviour will be performed, due to lack of this motivation (Cherry, 2018; Pratap, 2018).

Reinforcements – This may refer to both internal or external responses that are received in conjunction with a learner's behaviour, that can affect the probability of the learner either continuing or terminating the behaviour (Vinney, 2019; Dace, Stibe, & Timma, 2020). It can therefore represent learning as learners will react in accordance with the consequences of their behaviour and inherently this reaction will affect their environment (Kong, Deng, & Zhang, 2019). Therefore, reinforcements are closely linked to the reciprocal deterministic factor of SCT, as behaviour and the environment are influenced by each other. Reinforcements can be self-initiated or supplied by the environment, and can be either positive or negative, where positivity will encourage the behaviour to be repeated in future situations (Locklear, 2020). Bandura emphasises the concept of intrinsic reinforcement in SCT. It is described as a type of internal rewards for the individual learner, and may include notions of pride, satisfaction, and a sense of accomplishment when particular behaviours are enacted (Bandura, 1986). This emphasis on internal thoughts incorporates the concepts of cognitive development in the process of learning through behaviour (Pratap, 2018; Honicke & Broadbent, 2016). It should be noted however, that while personal experience of motivational reinforcement provides encouragement and positivity, so too can the observation of the experiences of others with reinforcement or punishment towards behaviour, be useful in reproduction of behaviour (Rolling & Hong, 2016). Therefore, reinforcement can take on an important role in motivating behaviour or not.

Expectations – The concern here is with the anticipated outcomes of a learner's behaviour. Bandura stated the outcome expectations are consequential from the observing of situations and events in the learner's environment, and also includes the actual outcomes which have resulted from previous behaviour or actions that the learner has taken (Bandura, 1986). It seems that individuals learn from and are motivated by outcomes expected of certain actions (Bandura, 1989; Maine, Dickson, Truesdale, & Brown, 2017). Learners often anticipate the magnitude and repercussions of their actions before actively participating in the behaviour, and these anticipations can have significant influence on the completion of the behaviour or not (Rolling & Hong, 2016). While expectations are largely derived from previous experiences, expectations tend to be more focused on the current value that is placed on the outcome behaviour and is consequently viewed subjectively by the learner (Gulsen, Erman, & Pinar,

2018). Hence, outcome expectations include the physical, societal, and self-evaluative consequences that occur when engaging in a particular behaviour (Knowlden, Robbins, & Grandner, 2018)

Self-efficacy- This is identified as one of the key concepts of SCT. Self-efficacy is instrumental in sustaining internal motivation (Maine, Dickson, Truesdale, & Brown, 2017). It refers to the self as a whole and is influenced by the learner's perceived capabilities and other personal factors, including the environmental factors, such as barriers and facilitators, which affect a learner's confidence to learn and perform specific behaviour (Knowlden, Robbins, & Grandner, 2018; Bandura, 1989). The self-efficacy concept therefore embodies self-confidence and persistence. In the SCT, self-efficacy is affected by four constructs which act both directly and indirectly on the learning and performing of behaviour. These are identified as: 1) *Symbolizing capability*: Everyone has the cognitive capacity which provides them with the means for understanding their environment and how it affects their own lives (Bandura, 1989; Knowlden, Robbins, & Grandner, 2018). In this regard cognitive factors can act in a symbolic nature and may partially determine which aspects of the environment are addressed among the countless we experience and what meaning is aligned with such aspects, including the potential emotional impact and motivating influences they may have, and how the information conveyed via these symbols are stored for future reference (Locklear, 2020; Honicke & Broadbent, 2016). By doing this, information transformation can occur, so that experiences can be streamed into cognitive models which can provide guidance towards motivation (Schunk & DiBenedetto, 2020). 2) *Self-regulation capability* – This involves the internal tools used for self-direction (Brennan, 2017). It may therefore progress along development that requires the gradual movement from primarily relying on internal regulation and direction towards external approvals and directives (Dace, Stibe, & Timma, 2020). A well-developed self-regulation capability can serve as a valuable motivator or deterrent of behaviour (Gulsen, Erman, & Pinar, 2018). 3) *Self-reflective capability* – This concept moves beyond the aspect of solely being a means of action but encourages self-examination to verify the quality of your own operative functioning (Vinney, 2019). Self-examination provides a way to evaluate the reliability of thinking. This can be achieved through self-reflection, whereby thoughts can be generated and acted upon or predictions can be made about outcomes (Rolling & Hong, 2016). The reflective process allows for the accuracy and functional value of thinking to be evaluated and utilized for the expansion and enhancement of thinking (Shrestha, 2017; Pratap, 2018). 4) *Vicarious capability* – This involves the capability to learn from witnessing modelled behaviour in the environment (Pfitzner-Eden, 2016). The environment provides a tremendous amount of information about

ways of thinking and behaving, including the norms, practices and values, accepted in social systems which is gained through symbolic experiences (Ross, Perkins, & Bodey, 2016). The main idea of Bandura's theory was to emphasise that most of the learning achieved by human beings, is done in a social setting or environment (Shrestha, 2017; Cherry, 2018). The learning experiences are affected by the environment, personal factors and social factors, all of which influence and are influenced by behaviour (Honicke & Broadbent, 2016). Social interactions provide opportunities for learners to gain knowledge, skills and strategies, rules, beliefs and even to create attitudes, based on observations, expectations and self-awareness, that acts from a cognitive perspective, to either promote or impede new behaviour (Pratap, 2018; Geerlings, Thijs, & Verkuyten, 2018). Therefore, SCT, emphasizes that mental processes are initiated by social activities in the learner's surrounding environment and as the learner develops, they begin to internalize processes that they may use in the future and they start to use them independently (Vinney, 2019; Knowlden, Robbins, & Grandner, 2018).

2.9 THE UNDERPINNINGS OF SOCIAL CONSTRUCTIVISM IN THE REVISED BLOOM'S TAXONOMY

Constructivists are concerned with understanding the learners' attempts to construct meaning (Mahmud, Yaacob, Ramachandiran, & Ismail, 2019). The branch of constructivism called, social constructivism emphasises the importance of social interactions, and environments which stimulate learning and knowledge acquisition (Bozkurt, 2017; McLeod, 2018). The Cognitivists prioritize and refer to the learner's schema as a systematized knowledge assembly where the learners themselves interpret knowledge and provide meaning to it (Taylor, 2018). Therefore, a comprehensive view from the theories of SCTCD and SCT when supporting the RBT, creates a framework that assumes that learners are capable of actively engaging in interactions and activities that enable the construction of knowledge and meaning, and that this occurs systematically through cognitive processes (Gorman, 2018; Wilson, 2016; Locklear, 2020). As the learner develops mentally, so too will knowledge construction develop, and this is often easier to achieve with the assistance of the learner's social surroundings (Iba & Burgoyne, 2019).

As the RBT supports the notion of building on knowledge, so too does Social Constructivism. The concept of learning is through active engagement and there is coherent use of different techniques in order to achieve mastering of skills that promote knowledge acquisition and cognitive development (Rahman & Manaf, 2017; Panjwani, 2019). Social Constructivism

applied to the RBT framework, stimulates teachers, peers and environmental stimulant forces, that motivates learners to maintain awareness in the learning process and also to be critical of new knowledge (Forehand, 2017). Thereby moving through the RBT levels, can be achieved through mastering of skills with social assistance and ultimately learners are able to apply these skills to new situations independently.

Moreover, learning is a lifelong journey and therefore requires new application and the building on prior knowledge in a continual process to grow as an individual and to become a more competent figure in an ever-changing world (Ross, Perkins, & Bodey, 2016; Vinney, 2019). RBT provides the framework for the most relevant skills to be acquired to be successful in new environments and challenges, while Social Constructivism principles, enable a social support system in order to achieve higher goals (Gulsen, Erman, & Pinar, 2018; Benjelloun & El Kirat El Allame, 2019).

2.10 THE RELEVANCE AND APPLICATION OF BLOOM'S TAXONOMY SUPPORTED BY SOCIAL CONSTRUCTIVISM, TO THE CURRENT STUDY

Facione, Gittens, and Facione (2016) state that according to a group of experts in the CT domain, the ideal critical thinker has distinct habits of inquisitive behaviour, displays trustworthiness, is well-informed and is unbiased in evaluations. They also show honesty and fairness in recognising personal biases, and are careful when making judgements, keeping these open to reconsideration. Ideal critical thinkers are very clear about issues, display a sense of order in the most complex instances, and are meticulous in the gathering of information and they are rational in their choice of data. Therefore, they attempt to ensure that their investigations are focused, and that their behaviour is tenacious in seeking outcomes which are accurately related to the matter and which take account of the conditions of the investigation. Critical thinkers would be able to work at the higher levels of Bloom's revised taxonomy (Nkhoma, Lam, Richardson, Kam, & Lau, 2016).

The RBT has provided a framework that can be used to assist with the development of critical thinking skills. RBT, working in conjunction with Social Constructivism, aids in establishing the cognitive skills necessary to facilitate CT, and by design triggers the learners' capability to enhance learning (Mahmud, Yaacob, Ramachandiran, & Ismail, 2019; Rahman & Manaf, 2017). The cognitive processes that are the foundation of CTS are intimately associated with

subject matter, content, and reflection which is guided by the RBT and Social Constructivist theories (Facione, Gittens, & Facione, 2016; Erikson & Erikson, 2018). Research has also validated that learners' early introduction to RBT levels has had remarkable power (Benjelloun & El Kirat El Allame, 2019) in helping them to develop their CTS (Deller, 2019; Soozandehfar & Adeli, 2016). This taxonomy can be helpful for a teacher attempting to move students through a learning process.

Early implementation of RBT, supported by Social Constructivism, is reported to have had much success in mathematics as well. The learning of mathematics is believed to be achieved through social constructions, because by origin, mathematics is social and cultural (Bozkurt, 2017; Rahman & Manaf, 2017). Therefore, social interaction and personal meaning- making, play an essential and fundamental part in the learning of mathematics. When teaching mathematics using RBT by teachers, the viewpoint of learners towards activities can be altered according to different conditions experienced in their learning environments and this makes learners understand, remember and then think critically about their tasks (Gorman, 2018; Locklear, 2020). The framework of RBT with Social constructivism, is thereby full of possibilities for the promotion of learners' CTS by teachers in FP mathematics.

SCDCT and SCT, also include the premises of metacognition and self-efficacy, emphasising the awareness of thinking critically on the part of the learner and self-evaluation of their thinking processes, while having the teachers engage in modelling of behaviour which promotes CTS, so that learning can be witnessed and retained for future reproduction (Cottrell, 2017; Bandura, 1986). Therefore, BT can be used to design the actual pedagogic instructions, but Social Constructivist strategies may be imposed to create, awareness, knowledge acquisition and reproduction of action (Geerlings, Thijs & Verkuyten, 2018). This engagement can influence both physical and cognitive actions, that directly encourages learners to think critically about their learning by self-regulation and by applying cognitive functions to accomplish tasks more efficiently (Nkhoma, Lam, Richardson, Kam, & Lau, 2016; Vygotsky, 1978)

Ultimately the promotion of learners' CTS is done in a very social and interactive environment, such as the classroom with teachers. The environment, according to social constructivism, enables learning by active participation in learning or by being an observer of desired modelled behaviour (Bandura, 1986). RBT and social constructivism working collaboratively can provide teachers with high and low level thinking closely linked with critical thinking so cognitive processes enable learners' cognitive development and CTS to become a part of all

learners' skillsets (Retno, Arfatin, & Nur, 2018; Nkhoma, Lam, Richardson, Kam, & Lau, 2016).

2.11 CHAPTER SUMMARY

This chapter distinguished the theories applied to create a theoretical framework for this study. RBT was identified as the central component of the framework, supported by social constructivist theories of SCTCD and SCT. The basic tenets of each were discussed, including how social constructivism supports RBT to collaboratively address the aims of the study and I attempted to establish the relevance of the selected theoretical framework of this study. Within the subsequent chapter, a detailed literature review is presented. This literature review includes the history of CT, definitions of CT and CTS, advantages and disadvantages of CTS, also addressing the promotion of learners CTS in South Africa and more particularly by teachers in FP.

CHAPTER THREE: REVIEW OF RELATED LITERATURE

3.1 INTRODUCTION

In the foregoing chapter, the theoretical framework was explored, focusing on how the interlinked application of BT, RBT, SCTCD and SCT provides a sustainable framework for this research study. Subsequently, this chapter will present a detailed literature review to demonstrate the relevance of promoting learner CTS by teachers in FP mathematics. The importance of a literature review lies in the researchers' ability to provide a wide range of information on the topic being researched, in order to create an understanding of the phenomenon and also to discuss what has already been done to address the research topic and how the key issues have already been covered (Hart, 2018). With this in mind, this literature review, will explore CTS. This chapter will provide detailed definitions of CT, what the skills are that are associated with CT, why learners' CTS should be promoted in the learning environment, the advantages and disadvantages of CTS, the impact of CTS on mathematics in FP, and strategies for teaching CTS in FP mathematics based on previous findings in the literature. At the outset, it should be noted that there is limited research available, regarding the promotion of learners' CTS by teachers in FP mathematics in the South African context. Therefore, this literature review makes use of a wide range of sources from both local and international perspectives, that covers the promotion of learners' CTS in early childhood education and in primary education.

3.2 THE HISTORY OF CRITICAL THINKING

In my preliminary research, while preparing for this research study, I learned that CT is not a new approach to inquiry, but has been around for many, many years. More than 2000 years ago the idea of CT emerged and was practised by many renowned philosophers and theorists, throughout the past centuries, up to this very day. CT was initially established when the sophists (740-399 BC) and Socrates (5th century BC) considered theories which affected the ways in which society was directed and the ethical influences of such theories (Majiet, 2016; Garcer, 2018). With regard to Socrates, in any attempt to truly understand the opinions of a specific subject, he had to illuminate the definition of that issue at the outset. This led to an evaluation of whether that particular definition of the issue was accurate or not. Socrates was renowned as a man who could think independently, and who had imparted the teachings of individual thoughts to others, so they could think for themselves. His strong belief was that thinking autonomously was a trait that had to be learned and if that was true, then people could be

educated to think critically (Carbogim, Oliviera, Toledo, Diaz, Bittencourt, & Pushel, 2019). In the past years, CT was distinguished as a focused domain that had to be taught individually as an entity on its own and not relative to any other issue or established via a course of study integrated with different content (Majiet, 2016). However, this has changed in modern education and I will aim to show how CT and the skills it provides can be promoted to enhance the quality of life for young learners.

3.3 DEFINITIONS OF CRITICAL THINKING

Over the years and after a host of research studies, CT has developed many different definitions, but also broad similarities, or general assumptions about what it truly is. To define CT is not a simple task, neither is it possible to conceptualise it in a succinct manner, because there are many prominent scholars who may provide their own unique definitions of what CT is (Wechsler, Siaz, Rivaz, Vendramini, Almeida, Mundin & Franco, 2018; Hitchcock, 2018). Scriven & Paul (2019) define CT as the intellectual process of actively and skilfully conceptualizing, applying, analysing and synthesizing and/or evaluating information, produced by observation, experience, reflection, cognitive reasoning or verbal debate. Similarly, CT means to think correctly in the search for pertinent, specific and trustworthy data in a specific domain. They also claimed that CT could be described as practical, philosophical, accountable, and dexterous thinking that is fixated on deciding what to believe in or what action should be taken (Borrero, 2018; Dowd, Thompson, Schiff, & Reynolds, 2018).

In recent years, the debates over what CT can be defined as, still persist. CT can be thought of as both a skill and a habit created within the cognitive realm to question, rather than just to accept any experience (Andamon, 2018; Geisinger, 2016). It is much more than a basic skill that can be taught to a person, in which they selectively engage, if required (Cottrell, 2017). Instead CT is more like taking on a particular position in order to view the world (Mokoena, 2019). Similarly, Mabaso (2017, p. 35) states that CT is predominantly about making complex decisions and being able to defend one's point of view. If CT is engaged in, then one can actively "identify and ask significant questions", and then critically evaluate and provide a reflection on the researcher's own course of work and similarly on the work of others. CT also equips one with the skill to analyse and synthesise problems, based on evidence (Arthur, Badertscher, Goldenberg, Moeller, Mcloed, Nikula & Reed, 2017).

A concise definition provided by Chigonga (2017) states that CT involves the process of evaluation within the process of thinking in its entirety. It is anchored in the notion of what the

initial reasoning was behind the conclusion that was arrived at. Complimentary to this definition is the prescription that CT refers to fair-minded thinking which is aimed at reasoning at the highest level of quality (Charlton, 2019; Forth, 2019). This fair-mindedness entails a thinking process in which the strengths and weaknesses of different points of view are considered (Snyder, Edwards, & Sanders, 2019). Without this ability, our thinking would be biased or, possibly, downright flawed (Mcpeck, 2016). I have thus far, tried to outline the definitions of CT from a number of different perspectives. The reasoning for this is, that there are a vast range of theorists and authors, who provide either simple or in-depth definitions of the concept of CT, some of which overlap or result in long-winded definitions which ultimately lose the essence of what CT is (Razzak, 2016; Forawi, 2016). This is supplemented by a statement, that there is no uniform, clear-cut and concise definition of what CT is (Paul & Elder, 2019).

3.4 CRITICAL THINKING SKILLS

3.4.1 What are critical thinking skills?

The term CTS, can be argued, is more suitably conceptualised as a collective of interrelated terms or concepts that are multi-dimensional and multi-faceted (Majiet, 2016). As with the multitude of definitions, similarly there are many different variations about what the skills are that are involved in CT. Many who provide definitions of CT do so by gathering characteristics of the ability to think critically. These characteristics may include judiciousness; the need to be systematic and analytical; inquisitiveness; a truth-seeking propensity and; open-mindedness and self-awareness (Chigonga, 2017; Ross, Perkins, & Bodey, 2016).

Research by Cottrell (2017) on CT also suggests that CT involves a multitude of skills, not just one, and a collection of these skills working together in an interlinked chain of thought, should result in a critically thinker. Therefore, for CT to occur, the person must inherently have to be able to produce information, understanding and must have the ability to formulate their own perspectives for evaluation (Benjelloun & El Kirat El Allame, 2019; Setiawan & Bharati, 2019). The critical thinker should also have skills of classification, analysis, the ability to find connections and relationships and a capacity to draw reasonable conclusions about them (Busch, 2017; Duran & Dokme, 2016).

Additionally, it was found that CTS should ideally include the ability to solve problems strategically via a logical path of inquiry and to show decision-making tactics which are evaluative (Kronenberg, 2019; Wade, 2016). Learners who are critical thinkers must have the

ability to think creatively and carefully to provide successfully supported argumentation which inhibits any form of guessing. Therefore, the thinking should allow for the drawing of logical conclusions based on specific principles so that, when providing or offering opinions, these are validated by evidence (Nordquist, 2019). Critical thinkers show distinct skills which imply a move away from general belief to the making of assumptions and, in moving away from the assumption- making, they develop hypotheses (Paul & Elder, 2019).

Chikiwa and Schafer (2018) followed a similar path in the identification of the skill set of critical thinkers. They say that skills associated with critical thinkers will let them identify the nature of an issue or matter at hand, whether it is familiar or unfamiliar, and decide on the necessary course of action which is required or the processes which are essential to solve the problem efficiently. This must also include a systematic approach to monitoring and evaluation of a problem and the process intended to be used for the solving of such an issue and make conclusions that are substantiated with proof (Tatsumi, 2018; Harris, 2017). Complimentary to this set of skills is the ability to react efficiently to new tasks and situations, and to process information effectively, which involves the ability to identify, categorize, draw comparisons, analyse and evaluate (Arthur, Badertscher, Goldenberg, Moeller, McLoed, Nikula & Reed, 2017).

Kruger (2016) and Carroll (2018) emphasised the vast array of skills that a critical thinker should master in order to perform higher-order thinking. These studies imply that critical thinkers must have skills to make use of evidence proficiently and objectively, and have the ability to organize their thoughts and to express such thoughts in a concise and coherent manner. Critical thinkers should be able to distinguish between what can be validated logically and insinuations which are invalid or unreliable (Cottrell, 2019; Forehand, 2017). Therefore, a skill of suspended judgment in the absence of appropriate proof to support a conclusion should be applied (Schmaltz, Jansen, & Wenckowski, 2017; Kaminske, 2019).

3.4.2 Interpretive skills

There are three common skills across most approaches which aim to identify the skills of CT, which are intrepretative, evaluative and metacognitive skills (Dwyer, 2017; Sumarna, Wahyudin, & Herman, 2017; Naimnule & Corebima, 2018). Interpretation is a three step process, to determine the degree of understanding that is needed to be able to focus the thinking on what is required (Papir-Bernstein, 2017). The first step is identifying what the dispute is and the potential value of probing the dispute (Tseng, Gardner, & Yeh, 2016; Harris, 2017).

An example of this is, in a FP mathematics lesson based on measurement, learners could be asked to estimate the length of the classroom. The learner may choose to ask for a friend's advice, and then evaluate all possible alternatives to getting an answer, before selecting the prime option.

The second step of the interpretative skills, would be to identify the reasons or support available which concur with your prime option (Hajhoseini, Zandi, Shabanan, & Madani, 2016; Mcpeck, 2016). Going back to the measurement lesson in FP mathematics, this step may include a rationale for taking the advice of your friends. Do they show a deeper understanding for measurement? Or have they physically measured the classroom? Consequently, there must be sufficient evidence to support your argument.

The third step is to analyse available data in order to gain lucidity (Kristoffer, 2017; Cottrell, 2017). This indicates a stage in which ambiguity and biases in your evidence are considered and questioned, as they may influence argument (Finn, 2018). Reverting to the lesson on measurement, this can be related to the advice taken from a friend. Does the learner take advice from the friend based purely on friendship and loyalty or because the friend has a better understanding of measurement?

3.4.3 Evaluative skills

Evaluation is an approach to determine how much acceptance you will grant to the argument based on the reasons you have understood or are to provide (Perry, Lundie, & Golder, 2019; Paul & Elder, 2019; Doyle, 2019). This determines the value of interpretations made in order to provide reasons and eventually to draw a conclusion (Facione, Gittens, & Facione, 2016). It is therefore a way in which the credibility of the argument is addressed. It involves the questioning of the rationale behind the conclusive argument (Papir-Bernstein, 2017; Cottrell, 2019). So, the FP learner, working on the measurement problem, may question if the derived answer, is plausible or believable. Moving forward from this, will be to examine the evidence provided to support the answer. The FP learner may determine if they estimated the length according to correct measurement strategies, and what the possible strengths or weaknesses are of their strategy. Finally, a holistic judgement of the argument should be made in terms of worth, where consideration of alternatives may be entertained (Ellis, 2017).

3.4.4 Metacognitive skills

Metacognitive skills are used to provide a means for evaluating and monitoring the particular

thinking you may have used during the interpretation and evaluation stages (Perry, Lundie, & Golder, 2019; Tseng, Gardner, & Yeh, 2016). This involves the analysis of your thinking during both the interpretative and evaluative steps. This step requires the relevancy of thinking to be questioned and also how clearly or superficially you understand the issue or argument (Sumarna, Wahyudin, & Herman, 2017). This is followed by an inquiry into possible personal biases and assumptions which may influence the interpretation and evaluation undertaken. This requires a means for questioning oneself about possible influences for decision-making and if there are favourable points of view that streamlined the conclusion. The last step in metacognitive skills, is to observe and intentionally apply possible thinking strategies that will afford the most operative assessment of the argument (Naimnule & Corebima, 2018; Setiawan & Bharati, 2019)

There are many different notions of what CTS are. As literature states, it is hard to define the exact skills which make one a critical thinker, however a broad idea of these skills are that it provides one with an edge in the personal and professional environments.

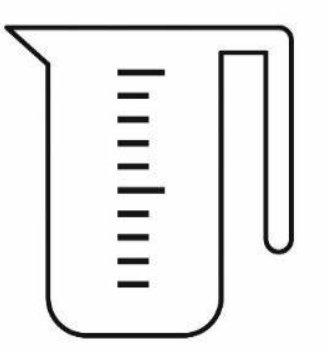
3.4.5 21st Century critical thinking skills

3.4.5.1 Problem identification and analysis

The foremost step is identification of the problem or main point and the ability to gather and process information and knowledge, to break up the problem into component parts, in order to find a solution (Cottrell, 2017; Tomaszewski, 2020). It may also involve, note-taking of smaller details that create a bigger picture (Garcer, 2018; Mcpeck, 2016). This process can then lead to the discovery of patterns within the data or even specific trends of repetition (Doyle, 2019; Nordquist, 2019). Learners may analyse questions or information and further identify what factors can influence it (Erstad, 2018), and therefore be more precise about what the actual problem is (Chigonga, 2017; Sanders, 2016). Therefore, the skill of analysing information or data can be characterised by the ability to break information down into its smaller component parts and to uncover how well these components work together and separately (Patel, 2018; Kristianti, Prabawanto, & Suhendra, 2017; Pacchiarotti, 2016).

Problem identification and analysis can be demonstrated in a measurement problem in FP mathematics, such as:

An empty jug is presented and learners are given the following information:



If one cup of water fills the jug to the second interval, then how many cups of water would be needed to fill the jug to the full capacity?

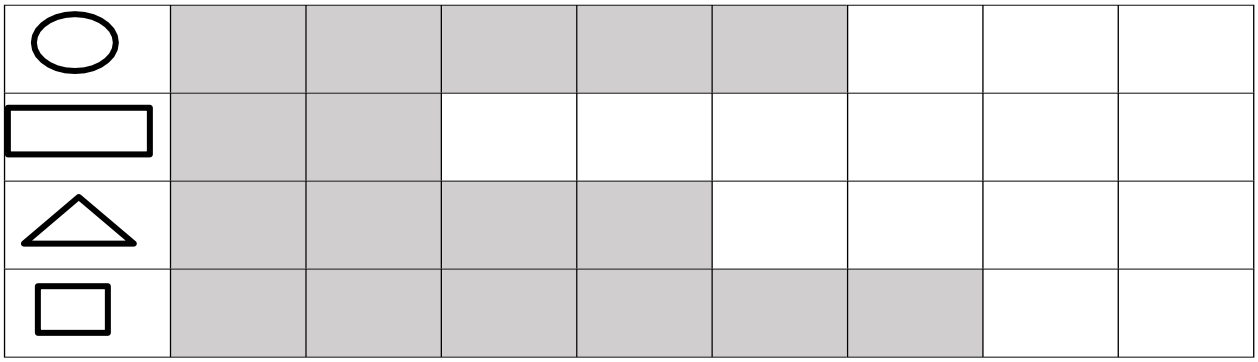
Learners would need to identify what question needs to be solved and what are the givens and unknowns:

- *1 cup of water = 2 intervals (given)*
- *To fill the jug to full capacity 10 intervals, need to be reached (analysis)*
- *10 intervals =_____cups of water (problem)*

3.4.5.2 Interpretation

This involves the discovery of and the concluding of what meaning can be assigned to information that has been processed (Chikiwa & Schafer, 2018; Kronenberg, 2019). It can be described as a communicative process drawing from relationships between numerical symbols and mathematical concepts, while addressing the effect each has on the other (Agoestanto & Sukestiyarno, 2017; Arthur, et al., 2017). Thereby being thoughtful about the importance of information. It is a skill that can be applied in FP mathematics, when learners are required to interpret a diagram or graph for completion of data handling activities.

For example, learners are presented with the graph below and asked to draw a picture to represent the graph.



Learners would need to interpret the graph, by understanding that each coloured block represents 1 shape and therefore interpret the graph by drawing: 5 circles, 2 rectangles, 4 triangles and 6 squares, and the drawing should show groups of each shape with the corresponding quantities. This would show an understanding of shapes, numbers and grouping and symbols.

3.4.5.3 Inference

The skill of inference refers to, assessing whether the knowledge you have is sufficient and reliable or not and ensuring your conclusions are being supported by the best evidence possible (Doyle, 2019; Gormley, 2017). Consequently, the skill may be demonstrated through the process of synthesis, whereby information is drawn together from different sources to create a specific point of view (Carbogim, et al., 2019; Cottrell, 2019). Hence, it may require research for the gathering of additional information to ensure a holistic view is possible. In this process of gathering information, classifications may be made according to the what information is important and what information is actually relevant to finding a solution (Tomaszewski, 2020; Hitchcock, 2018). Learners can make inferences by accessing prior knowledge or drawing from different subject content and being able to delve deeper into information, as some information may have little relevance to the problem you are addressing may not be presented or is not presented transparently (Erstad, 2018; Sanders, 2016). From what teachers know about mathematical operations, such as addition and multiplication, suggest that answers will be of greater value; and subtraction and division, suggests that answers will be of a lesser value, learners can make inferences when solving mathematical problems, such as:

Sipho baked a cake. He cut the cake into 12 pieces. He shared the slices of cake equally among his 3 friends. How many slices of cake does each friend get? ____

The word 'share' infers a splitting of an amount into smaller portions, hence from accessing prior knowledge of the different mathematical operations, learners can deduce that the division operation would be most suitable.

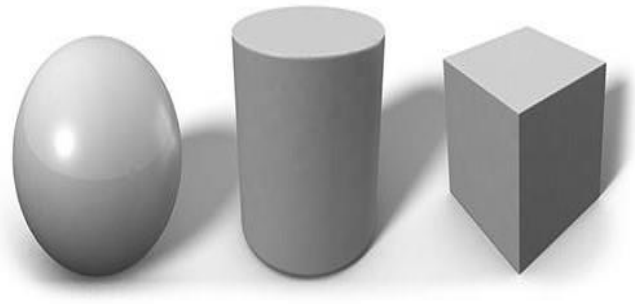
Hence, 12 pieces of cake, divided by 3 friends = 12 ÷ 3 = 4

3.4.5.4 Evaluation

It may also include the ability to make decisions based on the available information and going over the same information repeatedly to ensure that nothing has been overlooked (Erikson & Erikson, 2018; Paul & Elder, 2019). To an extent, it may involve the testing of the hypothesis, even if done mentally (Doyle, 2019), by questioning if the facts and figures you are leading towards, have sufficient support or can they be challenged (Erstad, 2018; Chigonga, 2017), insinuating a position of a judge be taken, to test results against applicable criteria and principles (Zayapragassarazan, Menon, Kar, & Batmanabane, 2016). Evaluating can thereby be a process of seeking evidence that may provide alternate views on the same topic or problem and to verify if biases exist (Cottrell, 2017; Tomaszewski, 2020)

This can be demonstrated in FP mathematics by presenting the following:

Learners are asked to look at 3 different three-dimensional shapes and choose the one, which can roll and the one that can slide. Drawing from prior knowledge on 3D shape properties, learners could differentiate between different properties of shapes to solve the question presented.



Balls can roll

Boxes can slide

Cylinders can roll and slide- Learners can draw from this information that the answer would be, a cylinder.

This can be evaluated further by learners having concrete objects which represent the three-dimensional shapes, so they can test each one before drawing a conclusion.

3.4.5.5 Explanation

This skill in many ways refers to the communicating of findings and being able to provide clear reasoning with elaboration or supposition (Shrestha, 2018; Wade, 2016; Doyle, 2019). It should be a presentation of a specific point of view that is well structured, clear and is supported by

reasons which can help to convince others to believe in that specific viewpoint (Patel, 2018; Busch, 2017). Hence it can be viewed as a skill to provide rationale for your thought process.

Drawing from the previous FP mathematical problem on three dimensional shapes, if the question presented required an additional substantiation for the derived answer, learners should be able to justify their answer so that the teacher could fully understand their reasoning for coming to such a conclusion. This may be suitable explanations:

Ball - sphere shapes can roll and because they do not have faces they cannot slide

Box – boxes have flat faces on each side and therefore can only slide

Cylinder - cylinders have two flat circular faces which allow them to slide but also have a round body which allows them to roll.

3.4.5.6 Self-Regulation

When applied, self-regulation can be viewed as a drive to constantly monitor and rectify your ways of thinking, by putting aside your own likes, beliefs and interests in order to achieve the most accurate understanding (Kronenberg, 2019; Jacob, 2018). It may entail the questioning of your own motivations and assumptions when viewing information or working with others (Erstad, 2018; Naimnule & Corebima, 2018). Hence it involves the notions of being alert and aware: awareness of yourself and others but more importantly, being aware of how you think about things and the underlying reasons for such thoughts, which can result in biases (Perry, Lundie, & Golder, 2019; Pratama, 2018). Self-regulation consequently is the ability to study and make observations of your own thoughts, feelings and actions (Ross, Perkins, & Bodey, 2016).

In FP mathematics learning, self-regulation offers learners opportunities to be critical about their own thinking processes when addressing different content and problems. It also allows learners a chance to observe how others think and therefore widen their views or thinking on different concepts and methods used when attempting to solve mathematical problems. This can be demonstrated by different solutions to the same problem, done by two different learners in a class activity:

If Thando, Jerry, Anne and Mpho have 7 balls each, how many balls do they have altogether?

___

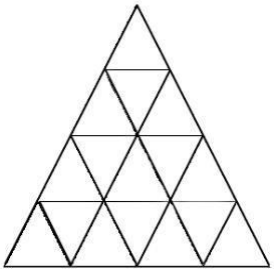
Learner A, answers by stating that 7 + 7 + 7 + 7 = 28. That is correct, however Learner B,

states that 7 x 4 = 28. From this Learner A can observe that there are alternative ways to solving the problem, which entails far less time consumption and that multiplication can be useful to solve problems, especially when applied to a time constrained examination.

3.4.5.7 Open-mindedness

The skill of open-mindedness can be understood as the consideration for alternative possibilities and multiple points of views, including possible exceptions or implications of conclusions made, by taking into account the possible strengths and weaknesses of such views (Wade, 2016; Alban, 2018; Tomaszewski, 2020). Hence, being open-minded acknowledges the consequences of the conclusions drawn with consideration for the effects they may have in either long-term or short–-term timeframes or both (Cottrell, 2017; Garcer, 2018). This skill is further about being able to distance one's self from a situation and not become ensnared, so that a broader, clearer and unbiased view can be generated (Hitchcock, 2018). Consequently, being open-minded is less about picking a side but rather about gaining insight into all perspectives, which consider all views and opinions, and drawing a reasonable and justifiable conclusion (Patel, 2018; Doyle, 2019).

If applied to FP mathematics, learners can be asked to discuss how many triangles they see in the diagram.



Learners may have different answers, but if given ample opportunities to discuss how they came to their answer, other learners who are observing can become more open-minded to different ways of looking at the diagram. Which answer is right or wrong, will be justified, and also which answer may be more right than the other.

3.4.5.8 Problem-solving

Problem-solving is the capacity to challenge unexpected problems by addressing the factors which contribute to the problem and finding suitable resolutions (Mcpeck, 2016; Guido, 2016).

It often entails a wide array of techniques which are aimed at challenging the unknown factors, which may hinder your pursuit of finding a solution (Chigonga, 2017; Erasmus, 2018; Patel, 2018). In problem--solving, learners usually find themselves out of their comfort zone and therefore learners are required to take a stance of responsibility for their own learning (Mulyanto, Gunarhadi, & Indriayu, 2018; Retno, Arfatin, & Nur, 2018). Problems are not straightforward and may require more than mere application of knowledge.

For an example, a FP mathematics problem is presented as follows:

Jack had 5 groups of 4 marbles. He gave Tom 1 group of 4 marbles. How many more marbles does Jack have now, when compared to Tom?

Learners could solve the problem as follows

Jack has 5 groups of 4 is: 5 x4 = 20

Tom has 1 group of 4: 1 x 4= 4

20 – 4 = 16

Therefore, Jack has 16 more marbles than Tom.

The answer would require different steps, with different mathematical operations and numerical symbols, and relationships between different values, which may challenge the thinking of young FP learners.

3.5 CRITICAL THINKING SKILLS IN EDUCATION

CTS are a prerequisite for the 21st century (Geisinger, 2016; Mabaso, 2017). In the 21st century world, having knowledge is insufficient. To be an effective asset in a working environment or even in one's personal and professional life, each person must be able to demonstrate good CTS.

CT is not a natural born ability. The basic premise of CT indicates that the skills required to be a critical thinker need to be taught, guided, developed and practiced on a continuous basis by learners (Scriven & Paul, 2019; Nordquist, 2019). Although some learners in the FP mathematics classroom, may display a curious nature, children are not born with CTS, and these skills cannot be developed appropriately along a natural path of life beyond survival-level thinking, therefore it is reiterated that CT is a learned ability that must be taught (Alban, 2018). All learners require guidance and need to be taught how to become skilled in investigating

systematically, and to be unbiased in their approach to evaluating the process of knowledge acquisition. This will assist with drawing reasonable conclusions and with the provision of supportive arguments in any chosen discourse.

However, as with any skill, CT requires training, practice, and patience (Bhatti, Al Farsi, Hasan, & Kazmi, 2017). CTS in mathematics require the learner to think independently about and to question their own thinking and thus it becomes a mental habit which entails thinking which goes beyond plain acceptance of information. It becomes rather a critical interpretation (Scriven & Paul, 2019; Australian Curriculum, 2019). Thus, the early introduction of such skills, by teachers in the FP mathematics classroom, encourages the progressive development of CTS and mathematical concepts, concurrently, as learners proceed to higher grades.

CTS have been a part of human progression for many centuries. Yet with our ever-changing global industrialisation and labour demands among economic distress, the need for CT is gaining more recognition (Geisinger, 2016; Mabaso, 2017). CTS are important because they provide an ability to learners from early FP years, to use existing information and to apply it to new situations, and to engage with the world critically. Learners can be effective also when dealing with social, scientific and practical problems (Dwyer, 2017).

One prominent factor that emanates from the Department of Basic Education is the development of learners' CTS in FP mathematics, to address the poor thinking abilities of learners and the instructional techniques which emphasise rote teaching (Department of Basic Education, 2018). According to Jojo (2019), this is one of the challenges encountered in South African educational transformation to ensure that learners have knowledge, values, skills, creativity and CT which are a necessity for the application and maintenance of democracy, and for promoting continuous learning, and social and economic development. In a democratic country, quality education is a basic need for all and that includes the development of critical thinkers. CT is often regarded as one of the fundamental aims and a dominating ideal of education (Dlamini, 2018; Kronenberg, 2019). The National Curriculum Statement of South Africa, implicitly motivates these notions, by declaring that learners should be engaged in "active and critical learning: encouraging an active and critical approach to learning, rather than rote and uncritical learning of given truths" (Department of Basic Education, 2011, p.4) and be able to "collect, analyse, organise and critically evaluate information (Department of Basic Education, 2011, p.5). Learners' CTS should consequently be central to the curriculum, because thinking without content is useless and similarly content gained without thought is mindless (Finn, 2018; Seale, 2017). Entrenching CT in the teaching of mathematics and skills

has a two-fold benefit: learners are more likely to master the outcomes set by South African CAPS outline, and CT will finally occupy a prominent role in the FP classroom (Arthur, et al., 2017; Dlamini, 2018).

Young learners armed with CTS, develop a confidence and an aptitude to deal with any mathematical situation without being mired in possible fears of mathematics (Department of Basic Education, 2018). Therefore, the teachings, guidance and training of CTS should ideally start from an early age, preferably in the FP years, so that learners have a longer period in which to become fair-minded and innovative thinkers (Majiet, 2016). Should CTS not be introduced and developed from an early age, the possibility of learners passively accepting figures and symbols without any contradictions could lead to adults who are easily manipulated in numerics (Jameel & Ali, 2016).

The benefits of early introduction of CTS is agreed upon by many other scholars (Hitchcock, 2018; Cottrell, 2017). CTS are proficiencies indispensable to the modern world, and the benefits of CT are everlasting in equipping learners with the skills to view their studies critically, and consequently enable these learners to grow into adults who can make significant contributions to their lives, their professions and to the world (Erikson & Erikson, 2018; Facione, Gittens, & Facione, 2016).

The need for teaching CTS is therefore to improve the thinking skills of learners and to better equip them to succeed in the world (Mcclung, 2017; Seale, 2017). CT is a skill that is required by all learners. However, these skills should be initiated and enhanced by instructional strategies which actively engage learners in the learning process rather than in rote learning (Haber, Sobel, & Weisberg, 2019). So, regardless of the characteristics recognized as CTS, since humans are not critical thinkers by nature they must practice and actively engage in this skill or risk having limited CTS (Chigonga, 2017).

3.6 ADVANTAGES AND DISADVANTAGES OF CRITICAL THINKING SKILLS

The central component of CT, is being able to question all forms of data that are presented, instead of mere acceptance of data at face-value. It also involves a process of systematic evaluation supported by a rationale. CT is therefore a higher order skill, much sought after and has a list of benefits (Chigonga, 2017). In the classroom, CTS provide better understanding and can improve the retention of information (Mcdunnigan, 2019; Cottrell, 2017). In FP mathematics class, attention spans vary. Discussing facts and questioning, encourages an

elaboration of knowledge at the time of learning while keeping learners interested (Guido, 2016). Incorporation of CTS into mathematic lessons, can allow learners to develop skills which can be applied to real-life situations, for example, quick mental calculations and critical thought can assist with managing spending money and saving.

Learners who possess CTS are often those who are vividly creative. Thus, a yearning to think critically about the world, directs itself to a yearning to provide creative constructive outcomes (Guido, 2016; Dwyer, 2018). Creative thinkers forego limitations and find possibilities. Learners who choose to take risks based on CT, are not lost in creativity, they are level-headed, and such a learner is often willing to move out of their comfort zones to achieve outcomes (Australian Curriculum, 2019). Creativity is also a part of the rudiments required for many jobs, especially those which require collaborative working environments. Careers in marketing and business puts much emphasis on creativity, and those who provide such creativity can thrive in the marketplace (Pacchiarotti, 2016).

CT is closely linked to curiosity, which helps us better understand the world and our own personal experiences (Carton, 2019; Aini, 2017). Many learners will continue to be curious about the world and its peoples. This implies a journey for lifelong learning, and ultimately of having a better understanding of and appreciation for cultures, beliefs and multidimensional views (Prince, 2019). Curious critical thinkers, also become good problem-solvers, which is beneficial to learners within a FP mathematics classroom (Sumarna, Wahyudin, & Herman, 2017). Problem-solving is about critically thinking about the problem and possible solutions. This is one of the most important skills, learners require. The young learners of today are the leaders of tomorrow, and they will address complex challenges using CT capacity to engineer imaginative solutions (Ruekert, Brand, & Sepher, 2018; Arthur, et al., 2017). The strong foundation of CTS can provide a strong foundation for problem-solving, which can prepare learners to take on intricate challenges. Problem-solving coupled with curiosity, provided by CTS, enables learners always to stay alert for opportunities to think critically, which in turn helps in FP mathematics, where learners are faced with problem-solving activities on a daily basis (Guido, 2016; Perry, Lundie, & Golder, 2019; Daniel, 2016).

Learner independence is also promoted through CTS. Independent thinking, means thinking for one's self and similarly enables a potential for leadership (Mcdunnigan, 2019; Razzak, 2016). It involves thinking about personal experiences and making observations to justify decisions critically. Enabling learners with CT independence, provides growth in confidence and a process of learning from mistakes, thereby improving their quality of life (Wechsler,

Saiz, Rivaz, Vendramini, Almeida, Mundin & Franco, 2018). Learners are equipped to solve mathematical problems independently, and in turn this empowers learners with skills to take on the challenges in the world when schooling is finished and teachers are no longer available to provide affirmation (Kay & Lauricella, 2018; Kronenberg, 2019). The advantages of CTS are evident beyond the schooling system as well. One of the key successes alluded to with CT is academic. More often than not, learners, who are able to question facts, draw comparisons or identify relationships. Those who can identify their own thoughts about their finding and express them, are those who have better grades and academic success in their future (Mcdunnigan, 2019; Retno, Arfatin, & Nur, 2018). Academic success based on strong CTS persists in learning throughout one's lifetime.

Being able to think critically, can further enhance one's ability to be more effective in a working environment, thereby improving the probability of professional success (Mcdunnigan, 2019). Employers are constantly looking for employees who can make reliable, valuable and significant contributions. Being able to identify opportunities, and to stand out from the crowd, can provide an advantage for career promotion (Mcclung, 2017).

These skills also allow for the building of relationships amongst a wide variety of people (Mcclung, 2017). One who is well versed with CTS, is able to evaluate the perspectives of others and have a better understanding of people (Guido, 2016; Alban, 2018). This ultimately will improve social relationships and provide smoother interactions (Mcdunnigan, 2019; Kristianti, Prabawanto, & Suhendra, 2017). This is helpful in group activities in FP mathematics lessons. However, with the multitude of advantages associated with CTS, there are noted disadvantages including the fact that independent thinking leads down the path of the unknown. CTS often spiral into a new terrains of thought, which can be disturbing and overwhelming (Guido, 2016; Mcdunnigan, 2019). Often values, religion and the very essence of your upbringing, can and will be questioned. This can result in immense discomfort with your world views, however with the use of CTS, you can find deeper understanding and new appreciation (Jacob, 2018).

3.7 THE INTEGRATION OF CRITICAL THINKING SKILLS IN FOUNDATION PHASE MATHEMATICS

There are distinct similarities between CT and scientific thinking (Dowd, Thompson, Schiff, & Reynolds, 2018), and since mathematics is a discipline which theoretically embodies correct, logical and scientific thinking, it is a reasonable deduction that mathematics is a platform which provides an opportunity to develop CT (Garcer, 2018; Kristianti, Prabawanto, & Suhendra,

2017; Sanders, 2016). Therefore, all CTS addressed above can be integrated into FP mathematics, where the introduction to number sense is in the foreground. Education has often in the past followed a monotonous path of routine memorization, however for learners to tackle the new world of education, a metamorphosis in teaching and learning must occur (Geisinger, 2016). A new focus in South African education policies is therefore moving towards the changing of cognitive skills, emphasizing learners' CTS (Jojo, 2019). When learners integrate CTS into their foundational mathematics, they are able to make reasonable and motivated decisions about what to do and how to think (Department of Basic Education, 2018). Learners engage in a consideration of the relevant principles or standards in order to reach decisive thoughts that go beyond guessing or the application of irrelevant rules (Chigonga, 2017). Learners can therefore take a mathematical problem, identify various strategies and choose a suitable strategy based on specific criteria (Erikson & Erikson, 2018). For example, taking a word problem, identifying the mathematical operations required and, why and how the mathematical operation should be applied to find a solution. This is indicative of learners achieving strategic competence in FP mathematics through CT.

According to a study done by Kristianti, Prabawanto, and Suhendra (2017; p.1) mathematics is one of the basic sciences that must be mastered by learners, especially in the early primary years especially the FP. The study claims that CTS can benefit learners by enabling the following attributes:

> "to organize and improve the students' reasoning sharpness, to clarify problem-solving in daily life, to train the ability to communicate by using numbers and symbols, to prepare students always to be oriented to the truth by developing a logical, critical, creative, objective, rational, meticulous, and disciplined mindset, and to be able to cooperate effectively; to nurture students to think regularly, systematically, and structurally. Therefore, teaching mathematics should not merely compile a sequence of information but should also review the relevance, usefulness, and interests of students in their lives".

An integration of FP mathematics with CTS can establish a means for a culture of critical mathematical thinking to occur, so learners are able to produce and appraise knowledge, and to pursue ideas and resolutions (Sanders, 2016). In SA and Globally, mathematics is a prerequisite for careers in Engineering, Computer Science and Information Technology (Jojo, 2019). However, a study done by Mabaso (2017) showed that in many South African classrooms the majority of learners in the Mathematics class do not participate in the class discussions and most do not answer questions when asked by the teacher, and they in turn do not ask meaningful questions in class. The study presented information, that learners were not getting ample opportunities, or they did not use their given opportunities to engage with CTS.

In South Africa, similar problem areas in mathematics education have been identified, where introduction of CTS will be beneficial (Jojo, 2019). It was found that many learners in the FP do not understand mathematical symbols, such as –, +, = (equals) sign. This latter symbol is neglected in the FP. The = symbol is often substituted by arrows and calculations are presented as follows: 2 + 3 → gives you 5 (Erasmus, 2018). Learners in FP are taught to read sums from left to right and memorise these procedures and symbols but this result in the learners showing limited understanding once they have to apply it (Arthur, et al., 2017).

If a mathematical problem is presented, such as 7 + 3 = + 1. Learners who don't fully comprehend what mathematical symbols will attempt to answer the sum from left to right: 7 + 3 = 10 + 1 = 11. They will add an extra = to answer the question based on the methods they were taught (Erasmus, 2018). Lack of understanding is further compounded when the sum is presented differently. For example: 7 +_= 10 (Department of Basic Education, 2018). The learner was taught to add or subtract groups. In this case, the learner sees a 7, a 10 and a +. The answer to the problem is then written as follows: 7 + 17 = 10. This is because the learner adds the 7 and the 10. Similarly, there is apparently a poor understanding of subtraction, for example: ___– 4 = 6 becomes 2 – 4 = 6. As difficulty levels increase over time, mathematical calculations become more thought-provoking, the = is merely the symbol next to the answer (Garcer, 2018).

This study alludes to the notion that no matter what teachers may do; they cannot think for their learners. "However, conditions can be created that encourage students to 'turn on' their brains and actively engage in learning mathematics through critical inquiry" (Chigonga, 2017, p.14). Initiatives to include CTS in FP mathematics, involve encouraging a thinking about how to think atmosphere (Seale, 2017), because the focus is less on what learners know, but more on what questions they can present (Prince, 2019). Learners who can successfully apply these skills to mathematics in early schooling years, develop a solid engagement and understanding of mathematical concepts (Department of Basic Education, 2018). This encourages a sense of greater independence and self-regulative thought in order to be competent with mathematical processes. Therefore, developing and guiding a learner to acquire CTS can only strengthen their confidence and their own learning in mathematics (Aini, 2017; Kristianti, Prabawanto, & Suhendra, 2017).

When CT is incorporated as a part of the daily routine, learners become vigilant to situations that appeal for thinking, and consequently they build up positive attitudes towards thinking and learning (Gelb, 2018). This propels learners' conceptual understanding, which enables learners

to see mathematics as an interconnected network of concepts (Department of Basic Education, 2018). Empowered with conceptual understanding, learners are capable of identifying associations between different concepts and of making associations between concepts and linked processes in FP mathematics (Andamon, 2018; Hoon, Singh, Han, Nasir, Rasid & Yusof, 2018; Erickson, Lanning, & French, 2017).

FP learners proficiently trained with CTS, embody good number sense and operations (Chikiwa & Schafer, 2018). They display mathematical confidence to make sense of problems and outcomes in different frameworks, and show abilities to recognise, describe and denote patterns and associations, as well as to decipher problems using numerical semantics (Chigonga, 2017; Seale, 2017). CTS in mathematics, also promotes the investigation of patterns and relationships allowing the learner to develop an appreciation of the aesthetic and creative qualities of Mathematics (Naidoo & Mkhabela, 2017); and through this study of chance, the learner consequently develops skills and practices for making knowledgeable choices, and for managing randomness and ambiguity (Department of Basic Education, 2018). Therefore, the introduction of CTS in the FP mathematics classroom, emphasises mathematical applications such as understanding symbols, variables, and equations which can provide a multitude of benefits to the learner throughout their future careers (Garcer, 2018).

3.8 STRATEGIES FOR TEACHING CRITICAL THINKING SKILLS IN FOUNDATION PHASE MATHEMATICS

A multitude of techniques are used by teachers to encourage the development of learners' CTS in FP education. These techniques can aid young learners to develop analytical minds and become relatively aware of their skills to tackle new problems (Halton, 2019; Sanders, 2016). Gradual inclusion of such techniques will lay the foundation for learners to build on and later master CTS. In FP mathematics, techniques can be introduced at the beginning of each lesson by intentionally encouraging a class discussion about mathematical concepts (Liljedahl, 2017; Martinelli, 2018). This will reinforce a culture of mathematical awareness, if maintained as an entry component to each lesson. For example, the inclusion of daily oral counting aloud or repetition of timetables for reinforcement, or short oral mental mathematics tests. Creating a culture of mathematics among FP learners can boost learner knowledge with mathematical concepts, making it easier for learners to access such information when thinking about solutions for mathematical problems (Kaminske, 2019; Attard, 2017). These daily routines may also lead to class discussions, whereby learners share their own strategies for solving problems, which

could be a learning experience for other learners to become aware of alternative methods to solve the same mathematical problems (Nilson, 2018).

Class discussions can also be done to solve new and unknown problems, especially when tackling new concepts (Wolpert-Gawron, 2017). By engaging in a class discussion to develop solutions, learners are able to work with others, share their thoughts, analyse the problem for different perspectives and evaluate learners' responses (Halton, 2019; Nilson, 2018). If administered with clearly aligned guidelines, class and group activities can provide a broader opportunity for CT to occur and questions to be raised about uncertainties, as well as for good debate about various strategies used (Haber, 2020; Su, Ricci, & Mnatsakanian, 2016). If learners are guided, to be respectful and observant in such activities, learners can develop new ways to think about problems, probing new lines of thought which would not be considered if problem was attempted individually.

Further mathematical computations can be modified to incorporate problems which are new to learners. This can be done by replacing original numbers with larger numbers or a different presentation to engage learners to think critically when attempting to find solutions (Haber, 2020; Liljedahl, 2017). In this way, learners will have to engage in theoretical knowledge and apply it to the new problem (Attard, 2017). This can be done through activities such as interpreting number puzzles or number games, such as giving learners a selection of numbers and symbols and asking them to create computations that equal to specific numbers (Martinelli, 2018; Ellerton, 2020). Number games like these, create open learning opportunities of CTS. Most often learners will choose to solve puzzles or such number games by using different methods. In this way, there are multiple solutions available, which can be observed, analysed and evaluated by learners (Schwartz, 2016).

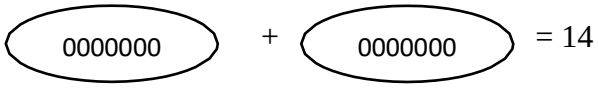
CTS through multiple solutions can be reinforced even further, via instruction. Teachers can ask learners questions of 'how' and 'why', rather than keeping to the basics of 'what' (Halton, 2019). So, instead of asking what is 7+7 = __ teachers can provide instructions which follow an open-ended path, giving learners ample chances to apply critical thought (Wolpert-Gawron, 2017). This can be done by asking learners how we can provide more than one solution to the problem, using alternative methods to solve the same problem (Ellerton, 2020; Martinelli, 2018). This will force learners to engage in critical thought, and not accept only one method as the ideal when solving problems (Su, Ricci, & Mnatsakanian, 2016). For example:

2 groups of 7 = 14

2 + 2 + 2 + 2 + 2 + 2 + 2 =14

2 x 7 = 14

7 x 2 = 14



Learners can be encouraged to be innovative in their thinking (Halton, 2019). When dealing with problems, learners can be guided to try and map out what is known and unknown first (Ellerton, 2020; Attard, 2017). By identifying the problem that requires solving, as well as what the learner knows, mapping out of different strategies can begin (Kaminske, 2019). This can lead to testing of hypotheses and learners being able to justify why their strategies have worked or not, and also if solutions could be viable or if they need to be recalculated (Liljedahl, 2017; Sanders, 2016).

The classroom atmosphere should therefore always be one of encouragement and nurturement (Martinelli, 2018). The techniques must be administered in ways which foster a positive environment for the development of learners' CTS. This can be done, by asking learners for their views and giving learners opportunities to rework their responses or solutions if need be. (Ellerton, 2020; Halton, 2019). Additional time may also be given, with constant reinforcement to persevere. Learners can also be given ample opportunities to role play out problems, especially those from word problems (Nilson, 2018). Creating concrete opportunities can produce a better understanding of the problem and opens the mind to different thought processes when dealing with similar problems in the future (Barshay, 2019; Wolpert-Gawron, 2017). CTS requires practice and by providing opportunities for corrections and extended time frames, more occasions are created for the development of learners' CTS (Kaminske, 2019; Schwartz, 2016).

Self-awareness is valuable in the development of CTS. By fostering a need to be aware of one's strengths and weaknesses in mathematics, learners can provide critical reports on how to improve and to provide reasons for such plans, through the process of reflection (Ellerton, 2020; Attard, 2017). This can be done, by introducing self-assessments whereby learners give themselves a mark, and have to provide a true reflection of their work to substantiate their mark or teachers can guide peer evaluations of learners' work to encourage fairness (Wolpert-Gawron, 2017; Liljedahl, 2017).

Additionally, the use of varying assessment methods from teachers, can be useful in developing CTS. If learners are given multiple methods of alternative assessment methods, then learners

can provide evidence of their own thinking and understanding of mathematical concepts and themes, which may prove to be more insightful (Haber, 2020; Attard, 2017). Assessments can be done, via song, dance, art (drawings or building of concrete models), and or speeches (Wolpert-Gawron, 2017). Learners can therefore show their thinking in different ways which are more creative, require inquiry, explanation and provide a means to showcase deeper analytical thought (Ellerton, 2020; Attard, 2017).

Teachers play a vital role in education as role models. Learners constantly watch teachers to observe their attitudes, behaviours and even thought. If teachers display positive behaviour towards CTS, learners can adopt such behaviour (Ellerton, 2020; Wolpert-Gawron, 2017). This may be possible, if teachers show fairness towards the views of others and teachers are not afraid to be wrong and find assistance from others, even from their learners (Nilson, 2018). This behaviour from teachers, may show learners how to align themselves positively with CTS. These techniques can be applied to the daily teaching of mathematical subject content, to aid with CTS development, by stimulating learners' curiosity, which can promote a habit of asking questions, and of prompting learners to provide explanations and justifications for their own thoughts (Nilson, 2018; Attard, 2017).

3.9 CHAPTER SUMMARY

From this literature review, it can be deduced that CTS is a valuable capacity that presents the potential to enhance the lives of learners, throughout their educational journey and throughout their lives. Promoting learners' CTS by teachers in FP mathematics, lays the groundwork for analytical and critical thought to develop in all aspects on young learners lives. Therefore, if introduced and strategically encouraged, CTS can become a beneficial part of learners' everyday thoughts. Early promotion of CTS, holds the potential of developing young individuals with the mental capabilities that can open new world views and prompt critical minds. Thus, the future of learners armed with CTS, will have the potential to be brighter and more successful, in education, employment, finances, relationships and life as a whole. The next chapter, will present and explore the research design and methodology that informed the way in which this research was conducted.

CHAPTER FOUR: RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

The preceding chapter focused on laying out a literature review on CT and CTS, discussing aspects of historical developments, the position of learner CTS promotion in FP within South Africa and the advantages CTS promotion presents for learners. The research design, is referred to as the process of research as a whole entity, which includes the conceptualization of the problem identified as a phenomenon to be explored, to deriving the research questions and includes the method of data generation, analysis of data, interpretation of data and the writing up of a full report (Cresswell & Poth, 2018; Aspers & Corte, 2019). Hence, the research design can be viewed as the rational arrangement of processes that create a connection between the empirical data established in a study from the initial research questions stated to the study's conclusions, which is demonstrated through steps to achieve the study's objectives and to confirm the validity of the study (Mukherjee, 2020; Hammarburg, Kirkman, & de Lacey, 2016; Tiley, 2017). Coupled with the research design, is the research methodology which provides the approach adopted in the study and is the route researchers assume to conduct their study (Hennink, Hutter, & Bailey, 2020; Silverman, 2016). The methodology aligned to the study, distinguishes the path of enquiry taken to address the research problem, and to satisfy the objectives of the study (Sileyew, 2019).

In this chapter, the research design and methodology for this study will be explored. The overall research strategy will be dissected to elaborate on the study's philosophical assumptions, research design from a qualitative perspective, the narrative inquiry approach adopted, as well as the research context, sampling techniques used, demographics of the research participants, data generation methods and instruments and analysis procedures. Additionally, the general trustworthiness of the design and methodology of the study, ethical considerations observed and limitations identified are explicitly stated.

4.2 THE RESEARCH DESIGN

The methodology applied in research is the "systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge" (Igwenagu, 2016, p. 4).

4.2.1 Interpretive paradigm

A paradigm is considered a worldview, which acknowledges a specific way of thinking about the world that includes the views on morality, values, principles, attitudes and belief systems (Croucher & Cronn-Mills, 2019). In research a paradigm offers a reflective stance of how research should be conducted and the methodological procedures which should be applied to the investigation (Kelly, Dowling, & Miller, 2018). Therefore, paradigms offer researchers opportunities to create identities and perspective, in which to view experiences and thought (Kankam, 2019).

This research study will adopt the interpretive paradigm. The aim of this paradigm is to locate and explore the multiple variations of meaning and interpretations, which provide information about specific phenomena (Croucher & Cronn-Mills, 2019; Blaikie & Priest, 2017). These explorations are underpinned by an intention to understand the underlying nature of the socially influenced world through the subjective experiences of participants (Burrell & Morgan, 2016).

Due to the social nature of this research study, the ontological component of the interpretive paradigm, identifies multiple realities and the meanings of these realities as being relative to the social system in which they are generated (Igwenagu, 2016; Kankam, 2019). This entails the realities of participants being influenced by societal values, beliefs, customs and culture. Therefore, the epistemology of the interpretive paradigm is subjective, thereby aligning interpretations and meanings to a specific phenomenon, relative to a particular time and context (Rahi, 2017; Munkfold & Bygstad, 2016). Consequently, the axiological assumptions of this paradigm, lead to an empathetic stance in the research process of generating data and to exploring a phenomenon, but also to the understanding that the research is more about expounding rather that deriving a conclusive end result (Darby & Fugate, 2019).

Since the interpretive paradigm, is concerned with providing an organized explanation and exploring the consciousness and subjective elements associated with human experiences, it was an appropriate match for this study (Croucher & Cronn-Mills, 2019). The fundamentals of this paradigm are to, understand that all experiences are influenced by societal and cultural structures and therefore researchers aim to understand how these structures impact on the human experiences and the meanings these structures create (Kumar, 2019; Gunabyi & Sorm, 2018). Hence, the interpretive paradigm encourages a stance of bringing back

participants to the phenomenon through emphasis of the structures of experience, to provide a deeper understanding of what has transpired or of what is currently occurring, and more specifically the concept of the promotion of learners' CTS by teachers in FP mathematics (Paul, 2017; Berkowitz, 2018).

Further aspects of the interpretive paradigm, include the naturalistic nature of research being conducted in the environment most familiar and known to the participants, creating ease and comfort, which is conducive to honesty in interactions and responses (Blaikie & Priest, 2017; Rahi, 2017). Additionally, research is done using a small sample, implying a non-reliance on statistics or numerical values, but rather a focus on research questions which guide rich descriptive meanings and interpretations from the sample group, and about the phenomenon from the perspective of a specific social context (Gichuru, 2017; Kelly, Dowling, & Miller, 2018). Taking these elements of the interpretive paradigm into account, it was selected as the most suitable paradigm to guide this research study.

4.2.2 Qualitative research

In accordance with the interpretive paradigm selected for this study, the qualitative research approach was applied. This is most often viewed as exploratory, thereby adopting a subjective stance, encouraging the researcher to delve into the position of the participants to better understand their interpretations and perspectives of the world (Hammarburg, Kirkman, & de Lacey, 2016; Silverman, 2016).

Qualitative research can therefore be identified as a process through which an improved understanding of a phenomenon is reached by making new substantial distinctions as a result of gaining closer proximity to the phenomenon (Aspers & Corte, 2019). In order to make considerable inputs about phenomena, the qualitative approach makes its inquiry from a naturalistic viewpoint and seeks to find deeper understanding by exploring the social aspects entangled in relevant participant's experiences (Cresswell & Poth, 2018; Moser & Korstjens, 2017).

Communication is central to the qualitative approach and relies on building rapport and thereby gaining insight into the reasoning which supports human thoughts rather than what those thoughts and behaviours are (Radu, 2019). Through communication, researchers are more inclined to use words rather than numbers, providing in-depth understandings about the research topic, by addressing the opinions, thoughts, feelings and experiences of the

participants (Tiley, 2017) and the participants provide the research with a wealth of information through an exchange of words (Crossman, 2019).

Through derived meanings from interpretations of experience, the qualitative approach claims to be able to achieve a deeper understanding from participants, and also to be able to identify the multiple realities that exist in human interactions with the same phenomenon, which is often dependent on the influence of the social context. (Rahman, 2017; Hennink, Hutter, & Bailey, 2020). The approach if often flexible to gain the most insight, and also encourages freedom on the part of the participants, to share and be heard, which can induce expressions of new dynamics in relation to the research topic (Eisner, 2017; Radu, 2019).

As such, the qualitative approach to research was adopted for this study, due to its suitability for small sample phenomenon exploration, to gain deeper insight through the recounting of personal experiences. Closer proximity to participants, allowed for rapport to be developed and information-sharing to be established with more ease. Additionally, aligned with the qualitative approach is the method of narrative inquiry which was implemented for this research study, and will be discussed next.

4.2.3 Narrative inquiry as a research methodology

The narrative inquiry methodology can be understood as a negotiated process of research, which seeks to understand and evoke human experiences, thoughts and feelings (Clandinin, Caine, & Estefan, 2020; Smit, 2017). The narrative inquiry methodology assumes that human beings make sense of these experiences, thoughts and feelings in their social world by means of imposing narrative structures on them (Visser, Du Preez, & Simmonds, 2019).

The basic premise of narrative inquiry is to understand how people make use of stories to interpret their experiences, the way in which they construct their knowledge and draw meaning from their experiences, and additionally how people live, tell and retell their own stories (Stauffer, 2020; Goldstein, 2017). Hence, narratives create opportunities for people to understand, describe and act within their previous experiences, which produces a story of how their world is interpreted and understood (Wang, 2017; James, 2018).

Narrative inquiry is identified as the study of experiences through storytelling (Clandinin, 2016). People have stories for most experiences in their lives and are therefore somewhat practiced storytellers, who tell and retell of their journey involving different experiences of

their lives (Hailman, 2018; Griffin, 2017). Through the inquiry process, researchers work together with participants to delve into these stories to create narratives and to that explore what meaning those experiences have in relation to their contexts, time-frames and with other factors (Shaw, 2017; Visser, Du Preez, & Simmonds, 2019). As a result, it represents a process for in-depth understanding of experiences, through composite communication, which produces constructed and comprehensive illustrations (Smit, 2017).

Narrative inquiry therefore, focuses on the personal truths of participants, and dismisses any objectivity, hence the research often relies on stories which are purely subjective, to highlight the multiple versions of realities that co-exist (Hennink, Hutter, & Bailey, 2020; Kumar, 2019). Researchers who immerse themselves in the narrative inquiry methodology, also acknowledge their own truths and the influence that their personal stories may have in the research process. Subsequently, these biases are embraced and recognized in all aspects of the research, and become a significant part of the inquiry process (Papathomas, 2016; Haydon, Browne, & van der Riet, 2018).

Moreover, narrative inquiry is based on the belief that all human beings come to understand life and its intertwined experiences through the narratives of storytelling (Clandinin, Cave, & Berendonk, 2017; Wang, 2017). Stories provide an essential component in the lives of people, in order to describe and share with others their experiences, thoughts and feelings (James, 2018; Hellman, 2018). In this way, narrative inquiry not only allows for stories to be shared with others, but also provides a means for deeper interpretations and understandings to be discovered, and additionally for the passing on of knowledge (Douglas, Usher, Woods, & Jackson, 2018).

In this study, narrative inquiry, afforded a dynamic medium to seek stories and to understand them in a specific context, and thereafter to re-present the stories of participants in a manner that engages an audience and conveys an arrangement of knowledge about the phenomenon being researched, in a way that supports better understanding (Griffin, 2017; Stauffer, 2020; O'Grady, Clandinin, & O'Toole, 2018; Lindsay & Schwind, 2016).

Due to the diversity entailed in the teaching and learning of mathematics in the FP, narrative inquiry was identified and applied as the most relevant methodology, to seek out and explore the stories of teachers who promote learners' CTS through mathematics. Further, narrative inquiry was able to establish in- depth stories, which highlighted experiences from a small sample in a manageable time-frame.

4.2.4 Research setting

This study was conducted at the * DIVERSE primary school in the province of KZN. (* A pseudonym was used to protect the identity of the school). This is a public government school, situated in eThekwini Metropolitan Municipality, in the suburb of Phoenix, north-west of central Durban. Diverse primary school was established 26 years ago, predominantly catering for pupils from the Indian community of the area, but over the years, through leadership and foresight of the principal, it has become a school catering for the primary education needs of the nearby poverty-stricken community, with its large population of Black South Africans.

The school is one of the largest primary schools in the province of KZN, consisting of an estimated 2395 learners spread over 8 grades (R-7). Additionally, there are 77 teachers employed by the DBE, 30 remedial teachers, with support staff members of 1 administrative assistant, 15 food handlers and cleaning staff. The FP, itself consists of an average of 1170 learners and 37 teachers. Each grade, has an average of 7 classrooms (A-G), which accommodate between 40-50 learners per class. The school, has a total of 52 classrooms, which include stilted classrooms, to accommodate the full learner population.

More than 90 per cent of the learners, are from the nearby informal settlement of Amaoti, where most of these learners are exposed to extreme poverty, with many descending from child- headed households or who are orphans, living with extended families. Their daily lives include exposure to lack of water, very poor sanitation, very little food, limited shelter and other basic amenities. To counteract some of these challenges, Diverse primary school, offers a feeding scheme, with daily nutritional meals provided to learners at the start of the day, stationery for all subjects and grades are provided at no cost to learners, and additionally, the school is a no- fee paying institution. The school is also recognized for their constant out-reach programmes to poor community residents, in attempts to provide learners and their families with basic necessities.

In South Africa, the DBE has created a ranking system of schools based on the rates of unemployment and literacy of the community in which the school is located (van Dyk & White, 2019). The range of such rankings is 1-5, with a quintile 1 ranking signifying a poor or impoverished school, and a Quintile 5 ranking signifying a wealthy and affluent school (Allly & McLaren, 2016). The justification for this strategic ranking, implies the notion, that schools situated and catering for the poorer communities, identified as quintile 1 and 2,

should ideally receive more funding from the government, than schools serving the wealthier communities (Ogbonnaya & Awuah, 2019). Moreover, due to it serving a poor community, Diverse primary school is identified as quintile 3 school, and is identified as a section 21 with function c, which means that the funds received from the government are used by the school governing body to procure their own supplies and resources for the school (Masuku, 2019)

The academic programme at Diverse primary school, is regimented within school hours, with structured plans, established by Senior Management teams, for stream-lined teaching and learning to progress throughout the year, with minimal divergence. Furthermore, the school, provides a comprehensive intervention programme held after school hours, for remediation in subjects such as English, mathematics and isiZulu. These programmes are guided by teachers from the school staff.

Diverse primary school maintains a larger than average teaching staff. Teachers are provided with teaching allocations according their subject specializations for specific grades. This ensures that teachers are well versed in subject content, curriculum policy documents and varied teaching techniques which are manipulated to attend to learner needs. Teachers are encouraged to further their education and to keep up-to-date with DBE gazettes and education policies. This in reinforced, through weekly Professional Learning Community meetings with all teaching staff. Furthermore, the teaching staff of Diverse Primary school, are well recognized in the community and province, for the numerous accolades awarded to them, for professionalism, excellence, and contributions made, in the education sector.

4.2.5 Sampling and participant selection

Sampling and selection of participants is one of the most important aspects of research and determines the accuracy of the research results (Singh, 2018). For the purposes of this study, the participants were characterized by a group of people who have common characteristics, and the total number of people in this group represents the size of the sample (Ferreira, Rabelo, Vieira, Pereira, & Andrade, 2018; Etikan, Musa, & Alkassim, 2016). Therefore, the sample selection will be further characterized as a subgroup of the mentioned population that is used to represent the entire group, and is ultimately selected by the researcher through a specific process of sampling (Hoeber, Hoeber, Snelgrove, & Wood,

2017; Rivera, 2019).

Multiple sampling techniques are available in research, however for the needs identified in this study, non-probability sampling was implemented. Non-probability sampling, is based on and reliant on the researcher's choice of sample which is most often identified as being accessible and available (Etikan & Bala, 2017). It was also, a suitable choice, as the researcher wanted to understand a specific phenomenon in greater detail, for one particular population rather than to provide results which could be generalized, which is in line in qualitative research (Setia, 2016; Valerio, et al., 2016). Both purposive sampling and convenience sampling, are methods employed through non-probability sampling, and were administered for this study.

Based on the objectives of this study, teachers were identified as the most suitable participants for the context of this study, because teachers are at the forefront of education and are ultimately responsible for teaching their learners new skills, helping these learners to develop, master and apply these skills to new situations. In this way, teachers are ideal informants of how the promotion of CTS takes place within the school educational setting, as they are trained to create new ways to teach, and to plan their lessons according to the needs of their learners and teachers understand that learning is a continuous process for themselves and their learners. Teachers are therefore good resources of knowledge and experience, to explore what, in actual fact, is happening in the classroom.

Purposive sampling was nominated, as the selection technique and this follows the judgement or subjective ideas of the researcher looking for a representative sample (Taherdoost, 2016), and only those people who have the relevant characteristic elements were selected from the population and were identified as the most suitable (Singh, 2018). Participants identified as appropriate candidates for participation in this study, had to be teachers of Mathematics in the FP, and had to be a part of the staff at Diverse Primary School.

Additionally, convenience sampling was employed. Convenience sampling, refers to the sample at hand, so samples are selected via means of recruitment, which could be a result of social ties, for example the selection of colleagues (Vehovar, Toepoel, & Steinmetz, 2016). It is also a sampling method used for quick sampling and enables an easier means to deliver results (Singh, 2018; Sarstedt, Bengart, Shalgoni, & Lehmann, 2018). Since, I am also a staff member at Diverse Primary School, access and availability to fellow FP mathematics teachers was easily achieved, and further reduced costs that could have

resulted from travel and alternative communication methods, such as telephone calls or email access.

For the purposes of this study, three FP mathematics teachers were selected from Diverse Primary school. I deliberately selected one teacher each from grade one, grade two and grade 3, hence a total of three teachers were chosen, based on the criterion of availability, willingness to participate, grade allocation and subject specialisation. Additionally, teachers had to have acquired a minimum of one year teaching experience in the relevant grade and in the subject of mathematics in the FP. Conversely, the exclusion criteria applied, were all non-mathematics teachers and those who were deemed to have limited availability to attend to the data generation process were excluded. Overall, the study, was guided by an interpretive paradigm, and aligned with a qualitative approach, hence sample sizes were small, manageable and focused on the quality of data, rather than on quantity.

Therefore, purposive and convenience sampling were applied for this study, as they helped to ensure that the participant selection provided a realistic representation of the wider population, and were capable of delivering rich data which were aligned to the study objective (Sharma, 2017). The overall aim of employing both techniques of sampling, was to protect the quality of data analysis by warrantying an amount of data that was manageable and able to address the research questions (Etikan & Bala, 2017; Ames, Glenton, & Lewin, 2019).

Prior to the commencement of sampling and selection, I provided Diverse Primary School management with a gatekeeper's letter to confirm approval for study by the DBE and to request permission to conduct the study from the heads of the school. Thereafter, suitable participants were identified with assistance from the Heads of Department from the FP division of the school. Selected teachers, were contacted telephonically, due to the social distancing protocols of the Covid-19 (Corona virus) outbreak, to explain the purposes and outline the procedures of the study and to discuss possible participation. Afterwards, details of safety, anonymity, withdrawal and feedback were explicitly discussed with participants and those willing to continue with participation in the study were emailed letters of consent, to complete and return to me.

4.2.6 Study Sample: A concise description of participants

Participant T1 – A grade 1 teacher, who has 25 years of teaching experience, 18 years in foundation phase, and more than 8 years specializing in mathematics in FP. She holds a

M+4 teaching qualification and an Honours degree in educational management.

Participant T2 – A grade 2 teacher, with 11 years of teaching experience. She holds a Bachelor of Education degree, with a specialization in Foundation phase teaching. She has been teaching mathematics as a specialized subject in FP for 4 years.

Participant T3 – A grade 3 teacher, who holds a National Diploma in Education, and an additional Advanced Certificate in Education, majoring in mathematics. He also has partially completed a B. Com Degree. He has been teaching FP mathematics for 2 years.

4.2.7 Profile of research participants

The profile of the research participants provides a summarized view of the participant's demographics, age, grade involvement and years of experience in teaching.

Table 4.1 Profile of Research Participants

Participants	**Gender**	**Age (Years)**	**Grade**	**Years of teaching experience**
T1	Female	55	1	25
T2	Female	35	2	11
T3	Male	33	3	2

4.3 METHOD OF DATA GENERATION

The generation of data in research, is envisaged as the process of collecting and selecting information on specific elements of interest (Igwenagu, 2016; Griffin, 2017). This is accomplished through creating an organized method, which enables the researcher to answer the study's declared research questions (Mbachu, 2018; Gombitova, 2019). The importance of data generation is based on ensuring that an accurate and honest collection of data is obtained (Moser & Korstjens, 2017). Hence, the overall aim for all data generation methods, is to produce/ generate quality information that can be extrapolated into a rich

data analysis and further allows the researcher to obtain substantial and trustworthy answers to the questions defined by the study (Kabir, 2016; Ainsworth, 2020). In the context of this study, the qualitative data generation, is structured to produce information for FP teachers' better understanding of the promotion of learners' CTS in FP mathematics, hence it relies on the subjective and collective experiences of teachers and their associated meaning-making practices (Flick, 2018; Paradis, O' Brien, Nimmon, Bandiera, & Martimianakis, 2016).

4.3.1 Reflective Journals

As discussed earlier, the methodology advocated for in this study, involves narrative inquiry. Narrative inquiry, encompasses the ways in which storytelling is acknowledged as a tool for reflection, and more especially when discussed in the context of education, these reflections refer to what personal knowledge teachers have and also how this knowledge is created and developed (Clandinin, 2016; Chan, 2017). Therefore, reflection can be used by teachers, through narratives of their own personal stories, to generate meaning and understanding for their teaching and learning experiences (Figueroa, 2018; Thomas & Kallarackal, 2020).

Concepts related to reflective practices were instigated by John Dewey (1859-1952) and later developed by Donald Schon (1930-1997), who characterized reflection as the practice by which one can become aware of inherent knowledge, thoughts and experiences, and thereafter draw from these to acquire newfound learning (Choo, Abdullah, & Nawi, 2018; Ni'ma & Surmadi, 2020). In academic and professional pursuits such reflective practice, most often entails journaling of reflections, which can constitute personal ideas, opinions, experiences and knowledge (Khan, 2019). Using one's personal stories as a base for RJs, is an approach to creating awareness, cognizance of feelings, and placing one's mundane experience within a cultural and social context, thereby giving meaning and understanding to experiences (Rodriguez, 2017; Clandinin, Cave, & Berendonk, 2017).

Reflective practices often occur at different levels, in order for meaning, understanding and depth to be discovered from experiences (Rolfe, 2017). The initial level of reflection involved the reciting or the rephrasing of the appropriate experience related to the topic being expounded on for understanding (Habibi, Eviyuliwati, & Kartowisastro, 2017; Hussein, 2018). The next level required the introduction and incorporation of personal elements, which typically includes a description of subjective emotions and feelings relating to the

experience (Sahin, Sen, & Dincer, 2019; Ni'ma & Surmadi, 2020) which then results in reflection which entails an assessment or analysis of the experience with the attached subjective components (Sabah & Rashtchi, 2016; Clandinin, 2016).

When these levels of reflections are evaluated, further consideration is given to when the act of reflection actually occurs. Reflection is then classified according to descriptors: reflection in action, reflection on action, and reflection for action (Bashan & Holsbat, 2017; Garrity, Keck, & Bradshaw, 2019). Reflection in action - refers to neutral, unbiased and objective observations throughout the experience (Choo, Abdullah, & Nawi, 2018; Jarvis & Baloyi, 2020; Ramage, 2017). Reflection on action - occurs after the experience and includes the thoughts derived from acquiring new learned information which was aligned with the experience (Mathew, Mathew, & Peechattu, 2017; Thomas & Kallarackal, 2020; Gillies, 2016). Lastly, reflection for action – takes place when the individuals synthesize their emotions, thoughts and information acquired from the past experiences, in order to make predictions and relevant plans for future experiences (Gheith & Aljaberi, 2018; Moses, 2019; Donati, 2016).

Journaling acts as a medium for the externalization of the multiple levels of reflection and provides documentation of the metacognitive processes and subjective thoughts and feelings that occur (Khan, 2019). Through journals, the author is forced to acknowledge the thoughts, feelings and positions taken in the experience, finding the relevant language to convey their subjectivity and in some manner, journaling enables authors to confront and address the experience, even if it may be difficult or avoided previously (Figueroa, 2018; Jones, Rivera, & de Rooij, 2019). Additionally, journals provide a method of having recorded notes about the experiences, which can be reviewed at later stages, which could generate the building of new perspectives and therefore new learning can occur (Ahmed, 2019). Hence, Reflective practices together with journaling, is valuable, because journaling experience alone does not mean learning, development, or even that significant knowledge is acquired, but rather it is the reflective practices involved, that produce meaning and that contributes to the learning curve (Branch & George, 2017; Choo, Abdullah, & Nawi, 2018)

Reflective Journals were selected as the primary source of data generation in this study, because they have been identified as a valuable component to understanding different professions. They are easy to implement; and they provide a depth of knowledge and are a good tool for both personal and professional development among teachers (Jones, Rivera,

& de Rooij, 2019; Thropp, 2017; Figueroa, 2018). Personal reflective journaling promotes a proactive approach from teachers for developing their metacognitive abilities; inquiring about certain topics more critically; promoting their self-empowerment by taking responsibility and ownership for the processes of their personal and collaborative experiences in teaching and learning (Ahmed, 2019; Clandinin, Caine, & Estefan, 2020; Jarvis & Baloyi, 2020). Therefore, in this study, reflective journals engaged participant teachers to become mindful and attentive to their thoughts, positions, and feelings in relation to the learning and teaching dynamics incorporated in their mathematics lessons (Ainsworth, 2020; Branch & George, 2017). Moreover, the reflective process through journals, can aid teachers with drawing from theories of teaching and relating these to actual practice, thereby creating a learning experience (Goldstein, 2017; Wang, 2017).

Reflective Journals also encourage the individual teacher to identify his or her purposes and goals in a situation, and writing about a situation that is complex and unfamiliar, has been found to be helpful because they prompt questions to the author about what resolutions are needed and how they can be achieved. In this way they promote productivity even in uncertain situations (Thomas & Kallarackal, 2020; Rivera, 2019; Sahin, Sen, & Dincer, 2019). This is useful to participant teachers as they relate to the teaching of particular CTS within their mathematics lesson, and thereby externalize their thoughts and reflect on their experiences, which may be new and uncertain terrain for some. Additionally, the reflective journal data generation tool, used for this study was guided by several open-ended questions to inspire reflection on specific aspects of lessons over a period of three weeks. The structure allowed for participant teachers to discover and frame their own truths through reflection, and the time allocation provided teachers with opportunities to move back and forth over their thoughts and experiences (Flick, 2018; Hailman, 2018; Kabir, 2016).

4.4 DATA GENERATION PROCESS

Participants for this study were selected via purposive and convenience sampling and were therefore easily accessible. Once ethical clearance was obtained from UKZN (see Appendix B) and the gatekeeper's letter was received from the DBE (KZN) (see Appendix A), the research site was notified of the permission granted from all stakeholders, and I began to contact participants. Amidst the Covid-19 (Coronavirus) outbreak in South Africa, I had to amend the initial plans of contacting participants directly, via an arrangement of physically meeting to discuss the research study, and had to change the methods of communication

used. I opted for a practical and safer option of addressing participants, through telephonic communication.

Each participant was contacted telephonically to discuss the aims, purposes, risks and processes of the research study. Participants were advised on what their role would be, on what would be required of them, and on the duration of their participation. Further, I explained in detail, all ethical implications involved, and the necessary considerations put forward to address these implications. Once participants declared satisfaction with the overall presentation and discussion regarding the research study and their participation, email addresses were sent to me, and each participant was emailed a copy of the consent form, for participants to read, complete and return.

Upon the return of the completed consent forms, I emailed copies of the RJ form to each participant and followed this, with a telephonic update with each participant. Participants were requested to open the RJ form on their computers, whilst on the telephone I proceeded to discuss the contents of the RJ and what participants would be required to complete, and how this was to be done. In this conversation, I endeavoured to be clear and unambiguous about freedom of expression, in the form of thoughts, feelings, and ideas. There would be no right or wrong answers so there should be no hesitation to write truthfully about their experiences and to be as honest as possible and to use as many experiences to illustrate their points of view. They were asked to avoid the limitation of using words only, as diagrams or pictures would be acceptable to exemplify their thoughts; and to write freely, as there was no restriction on words or space.

The data generation as guided through the RJ, was spaced over a three-week period. Participants were requested to refer to specific CTS covered in their mathematics lessons for each week and to write reflective journal entries according to their thoughts, feelings and ideas in relation to their personal experiences. Each RJ was designed to be focused on different CTS each week: Week 1, focused on *Problem Identification and Analysis* and *Interpretation;* Week 2, focused on *Inference, Evaluation* and *Explanation;* and Week 3, focused on *Self-regulation, Open- mindedness* and *problem-solving.*

Participants were asked to reflect on their experiences of teaching the CTS as an incorporated component of their mathematics lessons, including how they planned the lessons to integrate the CTS: what went well in the lesson, according to their plan to promote the particular skills with relevance to the intentional teaching method they chose; to reflect on unplanned experiences that took place within those lessons; referring to the

CTS focus for the week, what parts of the lesson would require follow ups and their reasoning for such a decision; how would lessons that include the CTS be extended for future incorporation; and would reflection on the possible changes that would be made be accompanied with justification of these changes based on their experiences.

The data generation process, began in April 2020, however due to the Covid-19 lockdown in SA being further extended, school closure was prolonged until early June 2020. Upon their return to schools, all participants were ready to start the RJ process, however the plans of the DBE in SA, amended the academic school year, and all learners in the FP of schools were directed not to return, as a result of health concerns in the country. For this reason, I agreed with participants, that the RJ would be completed as a reflection of previous lessons taught, prior to the Covid-19 lockdown. This was not a serious problem for the participant teachers, as each of them had more than 2 years of experience in teaching the CTS skills within their mathematics lessons.

As a courtesy to the participants, I extended the three-week timeframe for completion of the RJs, to five weeks. All RJs were completed and returned by the middle of July 2020. During this period, the participants were free to contact me at any time for clarity about the RJ or any related concerns. I constantly encouraged participants to be truthful with the reassurance of confidentiality and anonymity.

4.5 DATA ANALYSIS

The selected data analysis technique assumed for the present study was Thematic Narrative Analysis (TNA), which is most often applied to qualitative research (Evans, 2018). The combination approach of Thematic Analysis (TA) and Narrative Analysis (NA) allowed themes with related meanings to be derived. TA involves key characteristics which include a process of coding data methodically, then examining the meaning of such codes and establishing themes which provide a description of the social reality and truths (Vaismoradi, Jones, Turunen, & Snelgrove, 2016; Roberts, Dowell, & Nie, 2019). Coding of data enhances the potential wealth of information that qualitative studies can provide about a phenomenon (Nowell, Norris, White, & Moules, 2017) and allows for large datasets of information to be interpreted in new ways (Belotto, 2018), with the ability still to capture true reflections of participant's perspectives (Xu & Zammit, 2020). The Narrative Analysis (NA) component provides the focus on 'what is being told' (Bengtsson & Andersen, 2020), hence the content is central to the analysis, so that themes that are derived from the TA

process are interpreted to provide meaning (Ronkainen, Watkins, & Ryba, 2016). The combination of NA with TA, is applied to acknowledge the identified themes, establish an understanding and context of the participant's perspectives while drawing meanings, and providing an overall improved understanding of the phenomenon being researched (Andrews, 2019; Goddard, Armstrong, Kiely, Elliot, Charalampopoulos, Condliffe, Stone & Sabroe, 2017).

TA is therefore a means for identifying, compiling, interpreting, evaluating, consolidating, describing, and concluding on the themes found within collected data (Castleberry & Nolen, 2018; Nowell, Norris, White, & Moules, 2017). As an approach for analysing data, it is flexible and can be revised for the specific needs of each study (Xu & Zammit, 2020; Belotto, 2018). TA is also capable of yielding detailed multifaceted descriptions of data (Walsh, McClean, Doyle, Ryan, Scarborough-Lang, Rishton & Dagnall, 2019). However, while TA is a flexible approach, such flexibility has the potential to lead to inconsistency and limited coherence when emerging themes are identified from the data collected in the research study (Vaismoradi, Jones, Turunen, & Snelgrove, 2016). Despite this noted limitation of TA, it was still adopted in the study because, it has been found to be an accessible form of data analysis, easy to grasp and quick to learn for new researchers with limited experience in qualitative research (Terry, Hayfield, Clarke, & Braun, 2017; Roberts, Dowell, & Nie, 2019). Additionally, TA views the resourcefulness of the researcher as a fundamental component in the analysis and presentation of the results (Jones & Lynn, 2018), which can eliminate the factor of inconsistency, if the researcher affirms an epistemological position that can be supported by the empirical assertions of the study (Maguire & Delahunt, 2017; Yufe, Fergus, & Male, 2019).

The NA element, ensures that a focus is on what is being communicated in the participant's responses, as opposed to how it is communicated and, to whom. It is also important to establish the reasons behind the disclosure of such knowledge or information (Olusoga & Kentta, 2017; Goddard, et al., 2017). The transition from NA to the TNA, utilizes quotes or excerpts to represent a meaningful story that allows for exploration of personal experiences, which can be interpreted to find reasoning and understanding (Hoff, Lobo, Knudson-Martin, & Distelberg, 2018; Ronkainen, Watkins, & Ryba, 2016). Hence, through the interpretive nature of NA, it aims to acknowledge the contexts and to provide deeper understanding about the experiences related to the phenomenon (Andrews, 2019; Jones & Lynn, 2018).

TNA, views the researcher as a central component, who is responsible for coding, deciphering such codes, identifying themes and patterns in shared meanings across the data collected, finding the themes that work together and forming a coherent story with them (Maguire & Delahunt, 2017; Vaismoradi, Jones, Turunen, & Snelgrove, 2016; Walsh, et al., 2019). Hence, TNA was used successfully in this study, because I was focused and constantly referred to the theoretical framework and trustworthiness, as well as to the research design aligned with the study's objectives and research questions, to ensure the TNA was done thoroughly, to produce truthful and insightful findings with meanings to better understand the promotion of CTS in FP mathematics (Xu & Zammit, 2020; Taylor, Henshall, Kenyon, Litchfield, & Greenfield, 2018)

4.6 TRUSTWORTHINESS

Trustworthiness is an integral part of any study. In qualitative research, a study can be deemed trustworthy only if the reader judges the study to be so (Moser & Korstjens, 2017; Amin, et al., 2020). Therefore, the trustworthiness encompasses the persuasive factors used by a researcher to convince potential readers that their study offers transparency, honesty and integrity. Consequently, I addressed four key elements, which were: credibility, dependability, confirmability and transferability to establish clearly the rigor and trustworthiness of the study with readers and future researchers (Trochim, 2020).

4.6.1 Credibility

Credibility is a criterion that questions the researcher and requests that a clear link is established with the research study's findings and reality, in order to exhibit the truth of the findings drawn from the study (Trochim, 2020; Moser & Korstjens, 2017). Therefore, credibility determines whether or not the findings yielded from a study, are acceptable and conceivable information which is adapted from the original data collected from participants, and is interpreted correctly so that it is still aligned with the personal views of the participants (Amin, Norgaard, Cavaco, Witry, Hillman, Cernasev & Deselle, 2020; Perakyla, 2016). Moreover, the purpose of any qualitative research study is to describe, explore or understand a specific phenomenon from the perspective of the participants, therefore the research participants become the only individuals who can rightfully judge the credibility of the findings of the study (Nowell, Norris, White, & Moules, 2017; Taylor, Henshall, Kenyon, Litchfield, & Greenfield, 2018). Hence, credibility involves

the demonstration that the results of the qualitative research study are ultimately believable to the research study participants (Forero, Nahidi, De Costa, Mohsin, Fitzgerald, Gibson, McCarthy, Aboagye-Sarfo, 2018).

With this study, many strategies were implemented to enhance credibility in the research process which included detailed descriptions and explanations of the data-gathering process with participants, on a one-on-one basis with an understanding that questions could be asked at any time to provide clarity. Data generation was done via the RJs whereby all participants were requested to reflect on the same CTS covered in their lessons of mathematics. Additionally, all participants were allocated a RJ, via email or hardcopy, with the same guidelines and format, and advised that their journal was personal and could be completed as they saw fit, and using methods which they were more comfortable with, for example through drawings, diagrams, written or digital.

Another important aspect of credibility, is the technique with which the data, interpretations, findings and conclusions are shared with the research study participants (Moser & Korstjens, 2017). Through this technique, I allowed participants an opportunity, to clarify what their personal thoughts and intentions were, to correct errors made in interpretation, to challenge any findings, and for participants to provide supplementary information if they deemed it necessary. Hence, the presentation of data findings and interpretations were transparent and truthful.

I also acknowledged possible biases, as a result of being a part of the academic staff at the research site and as a fellow colleague to the participants. This was done through open communication with the participants at any time during the study, and even after data generation was completed. Participants were updated continuously, as to the status of the study. Finally, a meeting was held with all research participants for a final discussion and presentation of the research study findings and conclusions, to ensure that participants found true reflections of their personal stories illustrated in the study.

4.6.2 Dependability

The concept of dependability is based on the notion of replication or repetition in research findings (Trochim, 2020). Essentially, it refers to the trustworthiness of the study's findings, and if the same results would be obtained, if we could study to explore or observe the same phenomenon twice (Nowell, Norris, White, & Moules, 2017). However, in qualitative research, it would be nearly impossible to actually measure the

same phenomenon twice, with identical findings, because by definition of qualitative research, if research is done to measure the same phenomenon more than once, the research would be essentially exploring to understand different things (Hammarburg, Kirkman, & de Lacey, 2016). Qualitative research is based on the premise of participants' subjective understandings and multiple truths, and therefore a constant changing of perspectives, hence, findings are unlikely to be replicated, but can show consistency in relation to time, place and context (Lemon & Hayes, 2020).

In this study, I aimed to achieve dependability by ensuring that the research process adhered to a coherent and traceable path of exploration and that the processes were clearly documented, so any individual reading the study would be able to examine the processes taken, and provide a well-informed judgement with regard to the dependability of the research (Nowell, Norris, White, & Moules, 2017). Furthermore, I described in detail the context of the study in relation to the research site, participation demographics, purposes and aims of the study with clearly outlined research questions, producing an accurate setting and for potential readers to mentally identify consistency with the context, understandings, interpretations and findings of the study (Lemon & Hayes, 2020).

Additionally, I was able to have an understanding with all participants due to working at the research site as a fellow colleague hence rapport had been established prior to the research study (Perakyla, 2016). All participants were encouraged to ask questions or to raise concerns with me at any time; to be honest without fear of consequences due to anonymity; to express their thoughts, feelings and opinions in any way they were comfortable with; and the participants were assured that there were no right or wrong answers and no time or word count restrictions, so they could express themselves freely. Moreover, the dependability of a study encompassed the evaluation of the research findings and researchers' interpretation, and overall recommendations prescribed from the study, by the participants, and to ensure that all information stated in the study, was supported and aligned with the original data collected from the participants, which was achieved in this study by meeting with the participants to discuss the final findings and conclusions of the study (Moser & Korstjens, 2017).

I also adhered to all ethical considerations in this qualitative research study (Cresswell & Poth, 2018) which contributed to its dependability. Ethical clearance was obtained via UKZN and gatekeepers permission was obtained from the DBE (KZN) as well as the heads of the school research site. Furthermore, participants were assured of confidentiality and

anonymity through using pseudonyms and full reporting of process, procedures and findings of the study, together with full record-keeping of all documentation, including ethical clearance letters and data collected.

4.6.3 Confirmability

The criterion of confirmability concerns the need to verify whether or not the analysis process of the study was in line with the accepted standards and protocols for a specific research design (Trochim, 2020; Rodriguez, 2017). Hence, in qualitative research, confirmability entails the aspect of neutrality and the researcher ensuring the inter-subjectivity of the data (Lemon & Hayes, 2020; Rahman, 2017). This means that the interpretations made should not be a reflection of the researcher's particular preferences or perspectives but rather they should be the truthful transparent views of the participants that were evident in the original data collected (Aspers & Corte, 2019; Forero, et al., 2018). Furthermore, confirmability involves the notion that similar research study findings could be found, if carried out by other researchers, implying that data and interpretations presented by a study, are not products of the researcher's imagination but are derived clearly and accurately from the collected data (Moser & Korstjens, 2017).

Confirmability, therefore implies an emphasis on ensuring that the research reports clearly identify and state the truest reflection of the participants' socially constructed subjective realities and that these were aligned to the meanings intended by the participants (Rodriguez, 2017; Forero, et al., 2018). Hence, in this study I was able to establish trust, honesty and rapport with participants, due to my prior relationships with most of the participants, as colleagues. This familiarity, was a predisposition for truthful communication and transparency between the researcher and participants.

Additionally, I allocated a considerable amount of time to repeatedly reading through each RJ and identifying patterns or themes, whilst acknowledging the relevant literature and the theoretical framework of the study, which was the RBT and social constructivism. To further, enhance the confirmability of the research findings, all interpretations and analysis were subjected to a process of verification by the participants, whereby participants could provide amendments and additional input. Moreover, in order to minimize any bias and enhance neutrality, I presented the analysis and findings of the research to the supervisor, discussions and amendments were made accordingly.

Finally, to contribute to the confirmability of the study, I provided reasoning for the specific

choices made in the selection of theoretical and methodological frameworks throughout the study report, so that future readers and researchers could draw understandings of how and why choices were made for this study (Nowell, Norris, White, & Moules, 2017).

4.6.4 Transferability

Transferability in a research study, refers to the degree to which the findings and conclusions drawn from a qualitative research study, can be transferred to new contexts with a new set of participants, therefore transferability embodies the aspect of applicability (Moser & Korstjens, 2017; Cresswell & Poth, 2018). When reporting on a research study, the researcher cannot know who the potential users of the research are, and to which sites, settings or context, they may want to transfer the findings of the research to (Nowell, Norris, White, & Moules, 2017; Setia, 2016). However, in the research report, the researcher aids the concept of transferability by providing future potential readers and researchers with thick detailed descriptions of the context, participants and research process, to enable better judgement of transferring data into their own research setting (Forero, et al., 2018; Rodriguez, 2017).

To enhance the transferability of this study, I provided detailed descriptions of the school context in which the research was conducted which included specific characteristics, such as the socio-economic factors, size, location, population, layout and demographics, to provide the reader with mental illustrations of the settings and site. Further I described in descriptive details the data explored in the study, specifying the sampling techniques used, the sample size, the demographics of participant teachers, focusing on their level of education and experience, and the inclusion and exclusion criteria applied to the sample selection. Additionally, I stated the strategy adopted for the data generation, and reasoning behind the use of RJs, how the data were analysed and made references to the excerpts from these RJs, to substantiate findings in relation to the theoretical framework applied to this study. Ultimately, the degree of transferability lies with the reader or future researcher, to draw a judgement with regard to the degree that this research study can be transferred to their new context, and to provide sensible reasoning for their decision (Trochim, 2020; Lemon & Hayes, 2020).

4.7 ETHICAL CONSIDERATIONS

In any qualitative research, the attention to ethical issues is fundamental, throughout all stages of the study (Arifin, 2018). Defined ethical considerations in a study, aid in maintaining stability and balance between the prospective risks involved and possible benefits of the study (King, 2019; Myers, 2020). The researcher is ultimately responsible for ensuring measures are established in the study to promote ethical strength and transparency (Ryen, 2016).

As part of the initial steps taken, applications were made to professional and institutional ethics committees, to ensure conformity to the relevant recognized procedures and protocols were adhered to. Confirmation letters were subsequently received from the DBE (KZN) (Appendix A) and the Ethics Committee at UKZN (Appendix B), prior to the commencement of this study. Additionally, the completed research study report was submitted via UKZN, to the Turn-it-in software program which promotes academic integrity and identifies plagiarism. These tests and checks enhance the strength, trustworthiness and ethical foundations of the study. In line with ethical requirements, a consent-form was designed, presented and explained to each participant. Informed consent was obtained and this provided participants with full disclosure of what the research was about and what the participant's role would involve. The consent form used in this study, included the purpose, protocols, risks, benefits, duration of participation, voluntary participation declaration, withdrawal procedures and parameters of confidentiality (Head, 2020). This fulfils the right of the participant to be aware of all aspects of the study and the right to withdraw at any moment they may choose (Ryen, 2016)

After presenting and explaining the consent form, it was returned to the participants to give them time to reread the contents at their own pace and to return it, when complete with possible amendments (Appendix C) providing additional time to re-evaluate the consent form. This allowed participants to demonstrate their power of freedom to choose if they would participate in the study or not, without feeling obligated. By doing so, I further acknowledged the participants' autonomy, referring to their right to make their own personal informed decisions, which was supported by providing my contact information if any participant required clarity on any content in the consent-form.

As part of the ethical considerations made in the study, all participants were made aware that their identities would be protected throughout the recruitment and writing of the study

report. Identity protection, was engaged in with the use of pseudonyms to ensure anonymity and to uphold confidentiality of names or location which could be viewed as identifying factors (Ryen, 2016). I applied discretion with participants on this matter, to offer safety, freedom of expression and to reduce anxiety. Moreover, attention was drawn to, participation being based purely on a voluntary basis and withdrawal could be undertaken at any given time, with no repercussions or penalties, to the individual. Further considerations included no risks factors to mental or physical health and well-being, minimal potential of harm involved in participation, in keeping with non-maleficence concepts of ethical research (Heale & Shorten, 2017).

Additionally, I aimed to promote transparent, trustworthy and honest reporting of the research study, to eliminate potential factors that could be viewed as deceptive from future readers or users of the study (Arifin, 2018). Hence, to indulge in moral conduct (King, 2019), all participants were briefed about the study before the consent form was sent, all interpretations were validated by participants after the data analysis, and findings together with conclusions were presented to participants for approval once the final report was ready, prior to submission, to establish honesty, integrity, truthfulness and transparency in the research process. Affirming the study report with participants, provided a reassurance that true reflections of their stories were represented in the report, further enhancing the minimization of biases from myself. Overall, I strived to ensure that the study was aligned to the outlined aims, objectives and purpose, whilst maximizing the benefits of the study with minimal harm to all involved in or affected by the study (Myers, 2020).

4.8 LIMITATIONS OF THE STUDY

The limitations of a study are concerned with the possible weaknesses or shortcomings, or influences that cannot be controlled by the researcher (Radu, 2019). Hence, limitations can be viewed as an imposed restriction on the study, which has the potential to affect the study's results and conclusions, and should therefore be clearly acknowledged by the researcher in the research study (Theofanidis & Fountouki, 2019; Queiros, Faria, & Almeida, 2017).

The current study was conducted at a research site, where I am permanently employed and have been member of staff for three years. This could have affected the manner in which

the participants responded in their RJs, as there were prior relationships between myself and participants, as colleagues. Further, prior relationships with participants, could have resulted in potential bias from myself, especially during the data analysis process, as I am also a FP mathematics teacher at the school. However, to overcome biases that could have been a result of familiarity between the researcher and participants, direct excerpts and quotes were used to avoid data misrepresentations, to show true subjective responses and to promote neutrality, and additionally, the original data, analysis and findings were referred to my supervisor for discussion, revision and objective assessment.

Additionally, the size and selection of the sample, included three teachers from one school, which was limited and I could not draw generalizable conclusions, however this study was done with the aim of understanding CTS in FP mathematics, and not with an intention of generalizability. Moreover, the generation of data was done via RJs, which were meant to be completed over a three-week period, which was time-consuming. This was overcome, by engaging with participants and providing them with the RJs quite early in the research process. This enabled provisions for time-frame extensions to participants, which promoted ease and comfort for completion of data generation. Another limitation of the RJs, was that teachers were not trained to write reflectively, resulting in some reflections lacking descriptiveness, and another possible bias of the RJ, was one relating to honesty in the journal entries, due to shaded descriptions of true personal perspectives, as a precautionary measure because it would be read by another person. I, strived to negate these issues, by constantly reminding participants of the ethical considerations adopted in the study, to ensure anonymity and safe-keeping of all documentation, and further that only myself and my supervisor would have access to such documentation.

Finally, the guidelines provided in the RJs, could have created unforeseen discomfort in their responses or unwillingness to share their experiences resulting in incomplete narratives of experiences, due to isolated moments being reflected or the participants not wanting to write extensively for each guideline. This was addressed, when the completed analysed data were sent back to participants for their verification, confirmation, approval, and each participant was granted opportunities to make amendments and suggestions to ensure their true views were captured. It was later addressed again, when I met with the participants to present the final findings and conclusions of the study and to gain final approval from participants.

4.9 CHAPTER SUMMARY

This chapter showed how the research outcomes and findings were obtained, in line with meeting the outlined objectives of the study. The content covered, included the choice of research methods that were selected for the research process and the study's path of exploration. A strategy was identified and descriptively explained, through the use of an interpretive qualitative design, using narrative inquiry as the approach for RJs to collect data from participant FP mathematics teachers. Inclusive in the breakdown of the elected strategy, was the description of the contextual setting, sampling techniques and sample size, with participant depiction. The chapter also acknowledged the limitations of the study, and discussed the principles of trustworthiness and the vital ethical components that were implemented. The next chapter, will focus on the analysis of data generated from the teacher's RJs, using the thematic analysis method.

CHAPTER FIVE: DATA PRESENTATION, ANALYSIS AND INTERPRETATION

5.1 DATA ANALYSIS

The previous chapter focused primarily on the research design and methodology applied to this research study. A detailed explanation of the selected data generation methods was included, together with the techniques applied for the data analysis. This chapter will therefore concentrate on the presentation of data collected, the interpretations and discussion of the data from the qualitative data generation method, using the narrative reflections recorded in the Reflective Journals. The purpose of this study was to explore and understand the promotion of CTS in FP mathematics, and subsequently the technique of TNA was implemented as the most applicable form of data analysis to address the following three key research questions:

- What is the current situation regarding the promotion of CTS among learners in FP mathematics by teacher?
- How is this promotion of learners' CTS being enacted in the teaching of FP mathematics by teachers?
- Why are learners' CTS in FP mathematics being promoted by teachers, the way that they are?

The analysis process began by identifying common themes and classifying information from the research participant's RJs as raw data, and then organizing these themes in order to narrate the participant's responses to seek answers for the above-mentioned research questions. It is important to note, that this chapter includes verbatim quotes as a means to present true perceptions of the participant's views on the promotion of CTS in FP mathematics. Additionally, direct quotations enable stories and thoughts of participants to be at the forefront, whilst still offering support for the interpretations presented.

5.2 PRESENTATION OF DATA, THEMES AND DISCUSSIONS

This section's focal point is to present the data generated from the RJs which has been analysed and interpreted, using direct excerpts from participant's perspective. This data will be presented in accordance with themes identified in the participant's views recorded in their personal entries in their RJs.

Table 5.1 Themes to explore Questions 1, Question 2 & Question 3

THEMES	SUBTHEMES
1. Current perspectives on the promotion of CTS in FP mathematics	• Prerequisite outcome of CAPS • Secondary component in lessons • Limited timeframes and curriculum demand. • Need for additional teacher training • A valuable asset for learners.
2. CTS inclusion in daily teaching and learning of FP mathematics	• Multifaceted approaches used for CTS integration in the lessons • Learners engagement through a variety of learning techniques • Teacher as facilitator
3. Long-term benefits of promoting CTS in FP mathematics	• Inclusivity in learning environment • Enhanced communication and interaction in interrelationships • Guidance paving the way to independence • Improved quality of life

In the subsequent section, I present a discussion about the emergent themes from the data analysis process which was generated from participants at Diverse Primary School, through RJs. These themes were derived from a TNA process used to explore the current situation of the promotion of CTS in FP mathematics and how the promotion is taking place, as well as the reasons why it is being promoted in this way. Therefore, data presented are aligned with these themes and are explicitly founded on the empirical data collected from the participants.

Question 1: What is the current situation regarding the promotion of learners' CTS, by teachers, in FP mathematics?

5.2.1 Theme One: Current perspectives on the promotion of CTS in FP mathematics

5.2.1.1 Prerequisite outcome of CAPS

The DBE's CAPS stipulates the content knowledge and skills that learners in FP mathematics classrooms, need to become competent and confident in, and this includes CTS development. Teachers showed that they are well aware of DBE specifications with regard to CTS integration in lessons. Some teachers' reflections were based on years of teaching experience, while others discussed the use of CTS integration in lessons and made reference to the education received while completing their teaching qualification. With regard to the criterion of CAPS, participants reflected on their lesson planning as follows:

> T1: *"In my experience of teaching, critical thinking skills have always been a part of the department's list of skills that all learners should be taught as part of the teaching and learning throughout their schooling"*

Further to this participant T1 stated:

> T1: *"Also, from education policies in maths, it is emphasised that critical thinking should be included in lessons to help learners develop their skills and be able to use critical thinking inside and outside the classroom"*

From years of teaching experience, T1 draws on CTS development being a constant from the DBE's learner achievement requirement and CTS should be incorporated into to content knowledge in lessons, so learners can develop proficiency of CTS which can then be used outside of the school environment.

Similarly, participant T2, acknowledged that CTS must be integrated into the teaching and learning methods of mathematics as stipulated by CAPS. There should, however, also be an encouragement of learners to think critically, by introducing creative methods.

T2: *"Since critical thinking skills is an aspect of the Curriculum and assessment policy statement that needs to be included in mathematics lessons, this week I integrated problem identification and interpretation into my lesson by focusing on the maths concepts of counting patterns, repeated addition and problem sums I know that critical thinking*
skills are compulsory as a part of our guiding CAPS policy, however I will look into more creative ways to include it, in my lessons to get learners to think more critically about solving maths problems and use different levels of thinking with creativity"

Participant T3, reflected more on the training and education experienced at higher education institutions, which reinforced the ideals of CAPS and the implicit idea of developing CTS with learners.

T3: *"During my studies to become a teacher, I was encouraged to teach learners to be critical in the learning, as it was a requirement from the government policies that learners are proficient in critical and active learning, and the lecturers always advised that it is crucial to the ideals of CAPS. Critical thinking skills, are also a part of the curriculum goals and I think it is important in maths"*

The above extracts demonstrate a common understanding amongst teachers, that CTS must be included as a component in lessons, and should be applied to all aspects of the mathematics curriculum and further, as described and stipulated in the CAPS document,

5.2.1.2 Secondary component in lessons

Lesson planning is most often done in advance with learner needs in mind. The teacher is therefore in command of which aspects take priority in the lessons, manipulating the focal points of learning. Findings were aligned to teachers' perceptions on adding CTS as an additional component in their lessons. Participants seemed to share a common view on subject content dominating the lesson. Below are participant teachers' reflections indicating their perspectives on the position of CTS in their lessons:

T1: *"When I look back at my lessons, I know that the lessons were primarily centred*

on the concepts of addition and getting learners to understand the basic methods of solving addition sums. The critical thinking skills are definitely in the lessons but I include them as an additional part. I often include these skills, around the concepts that I will introduce and prepare for, for the week"

T1, expressed the view that focal points of the lesson were based primarily on content and methods for addition concepts. There is an inclusion of CTS development within the lesson but only as an additional component, rather than equal focus on content and skill promotion. Complimentary to T1's reflection, participant T2 confirmed that the inclusion of CTS, was a secondary aspect of the lesson:

T2*: "The focus of the lessons is to get learners to understand the basic mathematics of counting in patterns, recognising repeated addition and solving problem sums and being confident to apply it to new more difficult problems, while still helping to develop their critical thinking skills"*

Again, the comments made, indicate a prioritization on content, specific to mathematical concepts, which is followed by CTS promotion in the mathematics lessons. However, the participants also expressed the following:

T1: *"At the end of the week a written test is done on addition. Marking and recording of assessments are done to evaluate learners. This gives me an overview of the concept taught"*

Participant T1, demonstrated that the key point of assessment was based on the concepts being taught, and therefore the evaluation of such assessment would be interpreted only in terms of the conceptual knowledge. Little to no mention was made of assessing the CTS of learners and evaluating how learners understand and demonstrate CTS.

However, participant T3, made mention of the focal point of teaching and learning of conceptual knowledge taking place first, but still spoke about wanting to provide more opportunities for learners to practice their CTS. T3, confirmed that the curriculum is viewed as the only aspect that learners are assessed on and this leaves CTS promotion as a lingering part, that only receives attention when and if time permits:

T3: *"However, the focus of the lessons was more on the concepts of maths and weight, therefore I would want to reintroduce these critical thinking skills again to let students practice more. It is often the case that curriculum takes predominance over creative teaching techniques because there is always a time crunch to finish the syllabus in time for assessments"*

Diverging from T3's view on the position of CTS promotion, comments shared by T2, indicate that there is an apparent shift in educational goals, by identifying and assessing the development of learners based on CTS skills and detecting those that needed further scaffolding rather than only streamlining curriculum content and side-lining CTS. T2 articulated the following:

T2: *"By assessing learners I was able to evaluate how many learners ere capable of working independently and how many still required assistance. Most learners were able to think on their own and knew what step came next"*

Drawing from the reflections shared, CTS promotion is apparent in all participant's lesson planning and teaching experiences. However, priority in lessons is given to CAPS-aligned content knowledge coverage, followed by CTS development as an add--on component. Furthermore, reflections from T2 and T3 indicate that CTS is slowing aligning itself to become equally important in FP mathematics classrooms.

5.2.1.3 Limited timeframes and curriculum demand

Teachers are often faced with limited time allocations and vast amounts of curriculum to cover which require planning and preparation. Most often the teacher's management of content versus skill development, revolves around the issue of omission or reduced focus of teaching and learning of CTS. From shared experiences, teachers felt very restricted with the allocated timeframes and the large amount of curriculum to cover. In relation to this sub-theme, participant teachers shared the following:

T1: *"In most lessons I try to teach my learners skills that are useful to them, however sometimes this is not possible because there is a large amount of content from CAPS, and not enough time to complete the syllabus and assessments on time"*

Participant T2, also expressed that there were specific timeframes allocated to achieve her lesson outcomes, which were not achieved in the desired time due to challenges with learners not fully understanding concepts.

> T2: *"I experienced that some learners did not understand the concepts taught which resulted in teaching the same concept for the entire week, due to learners being unable to think critically or complete tasks for the planned duration. The concepts and skills outlined for the week, was therefore not achieved as I had planned."*

Participant T2, also mentioned:

> T2: "*In foundation phase, it is not always easy to stick to the time allocations because learners have different needs. So, I try take my time with learners that I feel need more examples and explanations. This sometimes means, I cannot complete my lesson plan as I wanted to. So, when I integrate critical thinking skills in the future, I will have to rework my lessons to ensure I do not overwhelm learners and I have enough time to complete my lesson"*

T3 also explained that there is a need for learners to practice their CTS, however there is not enough time to provide adequate opportunities for learners to do so, and the time allocated for lessons during the school day, does not suffice to fully integrate CTS and curriculum content.

> T3: *"Saying this, the lessons that follow should include problems that are not so simple and straight-forward. I would like to give students more abstract problems where they can really apply problem identification and interpretation. This would however need to be spread out over multiple weeks, because there is very limited time in the classroom, to cover content and engage with critical thinking skills. With the duration of the maths periods not being enough, a lot of maths curriculum to finish, and many learners needing to learn with different methods, time is very constricting, to really get my students to practice their critical thinking skills"*

From these participants' expressions, a common thread is teachers working with inadequate time allocations with large amounts of curriculum coverage, resulting in restricted opportunities for CTS promotion in FP mathematics lessons.

5.2.1.4 The need for additional teacher training

This sub-theme focuses on the aspects of professional development and training in relation to teachers being equipped to promote CTS in FP mathematics lessons. All participants expressed the view that they needed support and training to confidently and efficiently implement CTS integration successfully. Hence teachers expressed the view that they lacked the skills related to sufficient understanding of CTS promotion. Participant teachers from the study, indicated the following, in line with teaching training:

> T3: *"At this point, I know these skills are going to useful to my students in all subjects at school and even in their life after school, but I am still unsure of how exactly I will integrate these skills into my lessons and the curriculum for maths"*

T3 expressed some uncertainty with integration of CTS with FP mathematics curriculum and content teaching and learning in lessons, but still agreeing that CTS is beneficial to learners. Similarly, T1 shared the below sentiments:

> T1: *"Personally, I think I need to research the concepts of critical thinking skills, to become more knowledgeable about methods of teaching the skills in the maths syllabus. This will also allow me to adapt new ways to teach the skills, which can help learners develop. I know that these skills are useful for all learners and can be helpful to them even as they grow older and become adults, so I will ensure that I look at enhancing my own teaching skills."*

From T1's statements, there is a lack of knowledge and an admission to further research being done on CTS promotion to create better learning and teaching, that is innovative.

> T2: *"Overall, I think it is not an easy task to include critical thinking skills in all my lessons successfully because my prime focus is on the maths content, so I will endeavour to be more mindful to intentionally prepare my lessons in the future, and*

possibly work with other teachers on different methods of inclusion or ask for recommendations from heads of department"

T2, further acknowledged a discrepancy in being fully equipped to implement and initiate CTS in lessons. The participant also mentioned possible team efforts being needed to address this shortfall in training to rectify the way lessons are planned and carried out.

From these reflections, teachers projected that it was not their intention to focus on conceptual knowledge and to put CTS as a secondary aspect, however all participants expressed the need for more guidance and training in implementing CTS within their lessons.

5.2.1.5 A valuable asset for learners

From the examination of participant responses, teachers shared a common notion of learners benefiting from CTS in the classroom and whole school education, even conceiving CTS as an asset in the subject of mathematics and education. In this regard, teachers shared the following:

T1: *"From my understanding, skills like inference, evaluation and explanation are very good, helpful and useful to all learners, both young and old. These are] skills that can be adapted to all levels of education, and life after school. Being able to see that there is a problem, look for information to get answers, and speak about your methods to solve problems, can be used in maths or any part of their lives, because they can defend their own thoughts and provide their own thought."*

Evident in the response of T1, is the perspective of CTS providing learners with critical vision and inquiry, which is necessary in comprehending mathematics problems, but also learners being able to apply and transfer skills to other subjects, from FP classes to more senior grades.

Participant T2, agreed with such thoughts and also spoke about positive self-development and providing better circumstances for learners to produce superior thinking when attending to mathematics:

T2: *"These critical thinking skills are important for all learners to develop, because it can help them to become more aware of themselves and their own thinking. This will be helpful as they progress to higher grades, [to] be able to ask questions that gain them better understanding and provide explanations for their thought processes when addressing mathematics or other subject problems."*

Agreeing with other participants, T3, also believed that CTS has a direct influence on improving learners' performance in mathematics. beyond the matter of importance, the teacher also referred to instilling thoughts in learners, that encouraged the recognition of valuing education and the experiences, claiming that CTS can build confidence and this confidence can drive learners to deduce answers based on critical thought as opposed to random guesswork:

T3: *"Practice is very important for them to become more aware of the skills that are available to them and also because students will perform better in maths and other subjects if they can apply their skills well. Critical thinking skills can offer significance to their schooling life and give students confidence to get better results... If learners are confident to use critical thinking, then they will perform better in maths. They will understand concepts better and trial and error techniques will not be based on guessing but through thinking. They will also not rely on explicit instructions but will be able to look at problems and thinking about what is required and apply methods that can help them solve the problems."*

Drawing from the shared experiences of teachers, CTS is viewed as an asset that all learners will benefit from in the FP mathematics classroom and in the broader spectrum of education.

The teachers' narrative reflections regarding the current situation show that CTS is regarded as a compulsory component of the FP mathematics curriculum and is being integrated into lessons as an additional segment. Teachers are however finding difficulty with restricted time frames to complete the curriculum and shared a common view of needing training. This was arrived at through teachers' expressions shared in subthemes 5.2.1.1 up to 5.2.1.5.

Question 2: How is this promotion of learners' CTS being enacted in the teaching of FP mathematics by teachers?

5.2.2 Theme Two: CTS inclusion in teaching and learning of FP mathematics

5.2.2.1 Multifaceted approaches used for CTS integration in the lessons

CTS development is most often related to the educational teaching techniques and practices applied to generate an environment which is conducive to critical inquiry, and also promotes positive reinforcement of CTS. Teachers shared different approaches they used to attend to different learner needs and how they adjust their lessons accordingly. Reflecting on teaching techniques and practices applied to their teaching, participants shared the following:

> T1: *"Choosing different methods of teaching the same sums, allows learners to have options available to them and creates opportunity for decisions and choices to be made. Some learners may choose to work with only one method and others may want to master all, but also if a learner does not understand one method then they can choose to use another. This also encourages decision-making and perseverance when learning in the classroom. Learners are able to show different ways of thinking… I also think that rewarding learners with positive reinforcement worked well in my lessons because, that encouraged learners to participate"*

Drawing from participant T1's reflections, it can be said that using different techniques for teaching the same mathematical problem, encourages learners to analyse problems using different thinking dispositions and understanding that there is more than one correct method to solve problems. Learners therefore have a diverse repertoire of solving techniques to draw from when attempting to make connections and to interpret problems. Teacher T1, also believed that the inclusion of a reward system which provides motivation for learners to participate and to immerse themselves in the learning process more willingly would be desirable.

Similarly, T2 observed that use of particular vocabulary in the lessons, motivated learners to think more critically and to delve deeper into the content to identify, analyse and apply

appropriate methods when discussing mathematics concepts:

> T2: *"When giving learners problem sums, I intentionally used words to get learners to use critical thinking methods by first identifying words used in the story sum e.g. more, less, take away. By identifying these words, the learners were able to work out what method to use, e.g. Addition or subtraction……I ensured that I paused often to ask open- ended questions and to ask learners if they understood, then continued with the lesson. I also asked many questions to see by the show of hands and by how many answered correctly if there was understanding as I was teaching"*

T2, also spoke about the use of questioning, especially the inclusion of open-ended questions which was found by the teacher, to improve learner participation in the lesson and generate critical thought. Pausing and confirming learners' understanding before continuation of the lesson is also noted, allowing learners to think about the concepts and methods and communicate their position on the learning that is taking place.

Participant T3, also reflected on the appropriate use of clues and questioning techniques used:

> T3: "*I like using clues in the lesson, because it gets students to think and draw inference to other lessons. While the explanation part, gets learners to communicate their thoughts and help convince other students of their methods and strategies. Many students struggle with speaking in front of the class, but this will encourage them to build up their confidence, because there is no right or wrong answer, so long as they can justify their choices……I will continue with open-ended questions and class discussions to invoke students to think more deeply about maths problems and solve problems using critical thinking skills. this method is one of my favourites, because students take control of the lessons. Their questions and answers inspire each other to think and want to discover more"*

Resonating with participants' reflections shared, multiple approaches are used by teachers to integrate CTS into their mathematics lessons and appeal to learners needs, to provoke CT development.

5.2.2.2 Learners engagement through variety of learning techniques

From the examination of participant teacher's reflections, teachers encouraged CTS promotion in learners through different techniques to understand and work well with others, to develop individual skills as a whole and to improve communication, all the while keeping learners actively engaged in this process of discovery. In accordance with this perspective on teacher initiatives, below are inputs from participant teachers:

> T1: *"Working in small groups, would encourage learners to listen to other's opinions and help to evaluate the methods of solving the problem, and may also lead to new and different ways of solving the problem, which would help learners, especially if the new way was easier for them to understand"*

Also sharing their thoughts on learners working with others, participants T2 and T3 expressed the following:

> T2: *"The learners that did not grasp the concepts fully were re –taught the concept in smaller groups to ensure they understood. Working in the small groups, encouraged learners to participate with the help of their friends and understood concepts much better, when they could ask their friends for help or explanations."*
>
> T3: *"The introduction of group work is always beneficial to students, so learning can be done using different methods from different learners, resulting in different thinking in order to find the most suitable methods to solve problems. Students were grouped together in 3's. These small groups had students of different abilities and who preferred different learning techniques".*

These reflections show that teachers believe that collaborative learning has many benefits for the exchange of knowledge and for developing CTS.

Additionally, teachers reflected on active and investigative learning which they stimulate in their teaching and learning:

> *T1: "Some learners were more creative and chose to carry bottle caps and*

marbles and had written addition sums in advance to practice, which they carried. These marbles and bottle caps allowed learners to be active and more involved in the lesson. It was a very exciting experience for them, to get answers correct by doing their own calculations with concrete objects."

T2, also encouraged active and investigative learning in lessons, and disclosed the following:

T2: *"When explaining to learners, allow them to think as well as provide answers when you ask questions. In this way they are actively involved in the lesson and don't become bored."*

Furthermore, T2 also expressed the statement below:

T2: *"I also gave learners an opportunity to look around the classroom for the different shapes and identify concrete objects, which learners labelled according to the correct name."*

T3, included the role of learners in assessing themselves as active engagement in their learning and creating independence in learners. Therefore, learners are not reliant on teachers input and can make judgements on their own strengths or weaknesses, and move towards rectification of deficiencies:

T3: *"It is my belief that students have many opportunities to assess their own skills and the solutions they generate using these skills. Students are overly dependent on teacher evaluation. Self-assessment is not easy, but it builds independence. This also allows learners to be active in their independent learning"*

The articulation derived from the participant responses, describes teacher initiatives that promote CTS through learner-centered techniques, thereby providing teachers with more chances to develop learners as a whole.

5.2.2.3 Teacher as facilitator

Teachers are increasingly taking on the role of facilitation in the classroom and relinquishing the dominant roles of instructor. Facilitation was adopted in many different

lessons by teachers and it was found that teachers were happy with the outcome of lessons and positive learner behaviour that it created. In this study, teachers indicated immersion in facilitation, sharing their experiences as follows:

> T1: *"There were also a few learners who did not want to participate at first, but I showed learners how easy it would be, and some decided to try, which was positive. I used short story sums to encourage them to participate and offered positive reinforcement by the class clapping for correct answers. Reinforcement helped to get learners involved in the lesson without me forcing them and allowing them to be active and to learn by doing activities by themselves.*

T1, further reflected on personal positive outcomes from the facilitation experience:

> *T1: "I enjoyed being a facilitator of these lessons because it was good to watch learners question each other and learn from each other while working with the content. In other lessons, I ask questions and encourage responses for the most part of the lessons, but letting learners work in groups and actively contribute, I was happy with the lesson outcomes and the thinking shown by all learners"*

T1 showed that facilitation is rewarding for both the learner and the teacher, when administered to interest and engage with learners. From this experience, T1 alluded to giving learners a sort of freedom to work with others to find their own niche for solving problem. T2, shared very similar experiences, in embracing learner autonomy:

> T2: *"I had to give learners a chance to look for the objects and identify it by themselves, so that they would become more aware of the shapes around them."*

T2, went on to say:

> T2: *"I watched learners in these pairs, and rather than stopping them from talking and doing individual work, I waited until they asked for my help or explanation. From doing this, I observed that they were able to solve more sums on their own than I expected."*

Resonating with T1, T2 reported that providing learners with independence to discover

and learn, proved to be worthwhile, because learners surpassed even the teacher's expectations to work on their own and achieve positive outcomes.

Moreover, T3 conveyed analogous views to both T1 and T2, that there is facilitation present in lessons and by offering support without controlling the learning, learners tend to learn more and want to be involved:

> T3: *"One of the methods I used for teaching inference is to support learners when they went through a process of evaluation working backwards. I planned to do this by providing learners with different situations, to understand that there is more than one correct answer, and by giving clues, and asking them to find supporting evidence of the clues and explaining why they believe the answer is correct. From my experiences, students want to learn more if I stand back a little and let them lead. Students get bored with only listening and are happier to talk and discuss."*

These findings suggest that teachers do take on the role of facilitators and this role in turn, creates an environment that is conducive to the development and promotion of CTS in FP mathematics lessons.

From shared expressions from teachers' narrative reflections in theme two, it can be said that teachers are using multiple approaches to integrate CTS promotion into lessons and improve learner engagement through varied learning techniques, while the teacher transforms into the role of facilitator. This was drawn from participant teachers' experiences shared under subthemes 5.2.2.1 up to and including 5.2.2.3.

Question 3: Why are learners' CTS in FP mathematics being promoted by teachers the way that they are?

5.2.3 Theme Three: Long-term benefits of promoting CTS in FP mathematics

5.2.3.1 Inclusivity in the learning environment

For classrooms in SA, it is not uncommon to have a vast array of learners who exude

diversity in many forms, from culture, thoughts, and learning abilities and preferences. Findings showed that teachers want learners to welcome an attitude and mind that is open-minded. Inclusivity in the classroom, opens learners' thoughts to fully immersing in situations with others who are different, while still identifying as an individual. Teachers therefore see inclusivity as a subordinate of CTS development that helps learners to give and receive acceptance of others. The statements below, reveal the experiences of participant teachers pertaining to the benefits of inclusivity within the FP mathematics classrooms:

> T1: *"This also helped with the weaker learners, when they were partnered with learners who had a better understanding of the problems. This boosted the weaker learner's confidence when their team got answers correct. Working in teams was very good for making inferences and evaluating the correctness of their answers. Different views from different pairs also showed that there are multiple ways to solve the same problems with my guidance"*

> T1*: "I chose to do three methods to teach addition, and all learners were placed in groups of four. I chose to partner weaker learners with stronger learners to encourage assistance and peer learning"*

T1, shared experiences of using group work and partnering of learners with different learning abilities in lessons. The teacher partnered learners with better understanding or concepts with learners who seemed to struggle. This allowed all learners to be involved in the lesson concepts taught.

> T2: *"This was a good exercise, because the shy learners who do not normally participate in class discussions, had an opportunity to speak up and show other learners how they worked through the sums"*

> T2: *"Many learners worked in pairs, which was not intended but worked well. They helped each other to solve the problems and even weaker learners completed many sums. This helped weaker learners to complete the task, with assistance. Learners spoke about breaking down and building up numbers and explaining to each other*

why they did each step."

T2, believed that lessons were inclusive and catered to different learner needs, as learners grew more comfortable to express themselves and to develop their own thinking while sharing the experience with others, while working in pairs. Learners paired together, helped each other with the analysis and interpretation, and even gaining understanding to provide explanations. In this lesson, learners who learn independently and those who are dependent, have opportunities to work together and learn from each other. Inclusivity in the classroom therefore enhances the potential for a diversity of learners to engage in CTS.

> T3: *"When planning, I think all students have different needs and also need different amounts of time to think about the problems that I give them. Therefore, working according to a student's prospective and current learning likes and dislikes is important. Lessons need to be extended for some students with fewer problems and increased for other students. The students enjoyed the role-play and did well in understanding the breaking down and building up of money concepts. The role-play item was not initially planned, however because some students were finding it hard to understand the concepts, I decided to include the small activity. I think that students understand maths better when they can do exercises practically when they cannot understand from simple book and pen examples. This was done to show that students can learn the same concepts but sometimes it must be taught differently".*

Participant T3, included an activity that encouraged learners to get involved in a practical situation, related to real-life experiences. This activity contributes to getting learners ready to address problems outside the classroom but also shows inclusion of learners who learn better and create improved understanding by actively thinking in random scenarios. Further, T3, addressed the diversity of learners in terms of amounts and different levels of problems, which identifies with different learner abilities and additionally the acknowledgement of amendments to time allocations, as deemed necessary for learner understanding and development to occur.

Emerging from these reflections, teachers acknowledge that CTS enhances the possibilities

of inclusivity in the classroom and expands the individual perspectives to build rapport with others from different backgrounds and those that may have different abilities from themselves.

5.2.3.2 Enhanced communication and interaction in interrelationships

Teachers' narrative reflections showed a pattern of enhanced communication and superior interactions surfacing between learners. The views teachers shared, were related to learners benefiting from interactions with others, being able to express oneself, consider others views and critically analyse communication to gain knowledge and respond efficiently. In excerpts from RJs of participants in this study, teachers shared the following:

> T1: *"In this week's lessons, learners could also show how they could investigate to solve problems by themselves and work in groups. Working like this, would show learners how to develop relationships with others, respecting others view, teamwork and showing individuality."*

T1, also shared the following:

> T1: *"The lessons started off with what is measurement and how different things can be measured. I placed learners in larger groups this week, so they could get different views and opinions and also learn to positively engage with others. Communication was a big part of the lessons and each learner was encouraged to take the lead for at least one question."*

From these experiences, collaboration and communication are used as integrated methods to teach learners and develop their CTS. Therefore, T1's experience refers to learners building on their CT to communicate well with others and in turn communicate as a group.

T2, also reflected on the integration of communication in her lessons:

> T2: *"I planned to get learners to work in groups to discuss their methods and how to solve vertical addition in groups. From group activities done in previous lessons, I found that group work helps learners to talk and discuss their ideas and explain why*

and how they verbally and physically express themselves with others. This is also a good skill for working with others."

T2, reiterated the benefits of communication in lessons. When learners are able to communicate, verbalization of their thinking becomes an easier task to tackle. For learners working in collaboration with others, communication will rely on active listening, consideration for alternative opinions and views, sharing in learner strengths and helping others overcome weaknesses.

Resonating with T1 and T2, participant T3 added to the benefits of integrating CTS and communication:

T3: "*I encouraged working in pairs. Working with others, supports the choices we make on how to respond to our emotions, feeling and ascertain [gain] control over our interaction with others. If students can consider the opinions of others, respect individuals who are different from us, and find a means to look at all problems and find suitable solutions together, then students would be successful at all skills, self-regulation, being open-minded and being able to problem-solve."*

These findings reveal that CTS provides a foundation for better understanding and communication as an individual entity and between other learners, and further encourages and supports positive interactions with fellow learners and teachers.

5.2.3.3 Guidance paving the way to independence

When teachers immerse themselves in facilitation, it is with the hope of getting learners to take the lead in learning and to develop a sense of independence. Findings revealed that learners who are exposed to the practice of CTS at regular intervals, slowly move away from requiring teacher instructions and rather use their own minds to critically think and learn. The following statements were shared regarding developing CTS and independent learners:

T1: *"Allowing learners to find the answers on their own was very rewarding when*

learners achieved their outcomes of the lesson on their own. Learners only asked me to get involved when they need reassurance and confirmation. It was good to see my learners taking the lead in their education."

T1: *"I think this would show that answers can be different and still correct, and also encourage the weaker learners to take the lead in all the groups to develop their skills. They would become more confident to solve problems and also to accept the help of others but still make the final decisions*."

T1 acknowledges that when learners engage in lessons that promote thinking and demands CT, independence can be achieved. The experience offers a two-fold reward, learners wanting to work independently only seek assistance when they reach roadblocks in their thinking, and the teacher, feeling positive towards the experience, can devise more lessons that promote CTS development and independence in the future.

T2: *"Observing ques on learner's findings are also important to extend self-regulation. I will ensure that learners always have an opportunity to try new things and consider new ideas."*

T2: *"include more lessons that let learners take the lead in learning and helping each other and teach the concepts but give learners more chances to apply their minds and even work in pairs or groups to solve problems on their own before I move to new topics*

From T2's experience, the teacher waited on learners to direct the lesson through 'ques' This allowed learners to take a position of control over the learning that would take place and also the timeframe they required to work on their investigation to understand and solve problems.

T3: *"For now, I will continue with open-ended questions and class discussions to invoke students to think more deeply about maths problems and solve problems using critical thinking skills. This method is one of my favourites, because students take control of the lessons. Their questions and answers inspire each other to think*

and want to discover more. I prefer to only intervene, when I think the discussion is moving off topic. This way, I am preparing them to become independent and develop their skills"

T3, expressed the benefits of discussion and questioning to provoke an open discussion which is led by the learners and encourages independent thinking that follows on building understanding from others, with others, and to draw personal conclusions. The teacher plays a role in keeping learners focused on topics, but does not agree or dismiss learners thinking, creating an open environment for personal views, confidence to speak and to identify in the class from an individualistic independent position.

Drawing from the shared narrative reflections of teachers, it is evident that in the FP mathematics classrooms, teachers are taking on the role of facilitator and waiting on learners to request guidance which is encouraging learners to become more active in developing their independence by applying critical thought.

5.2.3.4 Improved quality of life

When one applies CT to everyday life, it can offer multiple benefits that improve the overall quality of life. The findings of this study, showed that promoting CTS in the FP mathematics classrooms, lays a foundation for a better future, through exposure to real-life situations and applying CT to activities that can be referred to outside the classroom as well. From the examination of teachers' narrative reflections, participants highlighted the following:

T1: *"Working in groups, would show learners that there is always more than one opinion, view and way to measure and learners should be respectful of others even if they don't always agree."*

T1: *"Being able to look for information to get answers, and speak about your methods to solve problems, can be used in maths or any part of their lives, because they can justify their own thoughts and provide their own reasoning…Also, by explaining the answers and with the method, it would make learners more confident to speak up and make their voices heard and help other learners to understand the problem and the*

solution."

From the reflections expressed T1, learners who have time invested in CTS practice, show an enriched view of the opinions of others, developing ways to communicate with confidence and actively search for information independently to gain greater knowledge and are unafraid to share their own thoughts. Similarly, T2 shared the statements below:

> T2: *"Once learners develop skills it will lead to improve academic abilities. Learners should be allowed to express themselves more. Cultivating an open mind is a valuable outcome of critical thinking and reasoning".*

> T2: *"These critical thinking skills are important for all learners to develop because it can help them to become more aware of themselves and their own thinking. This will be helpful as they progress to higher grades and [it is] also a good trait to have when searching for employment. Problem-solving and being open-minded, are things that employers admire when looking for staff for a lot of jobs."*

An important reflection from T2, was the cultivation of an open mind, improved academic performance and creating self-awareness.

> T3: *"This role-play activity reinforced the concept of money, but also engaged with students to think critically about making decisions about budgeting, saving, what and how to use money, so that they are confident to make good decisions with their money in the future."*

> T3: "*Students still need much more practice with these skills. I will try to provide more role-play activities, because students enjoyed it, but also I think it will benefit students to become more experienced with these skills. Inference is important because it can help students make better decisions, when they are able to see different perspectives and getting as much information as possible about anything from, jobs, money, peer pressure choices. they can also decide if their decisions will be worthwhile or not and explain the reasons for their choices."*

Drawing from T3 statements, learners who have a base of CTS to refer to, should make

better choices with regard to money matters, which is valuable in a country beset with poverty, good financial planning is necessary for survival through saving sufficiently to avoid debt (Miller, 2020; Nold, 2017). It is also agreed that CTS enhances prospects of job opportunity and improved life decisions which are not influenced through peer pressure.

From these findings, it can be said that developing learners with CTS has many benefits that enhance life in the current years, and in the future. CTS offers individuals a skillset that can be applied to all aspects of relationships, employment, finance and education.

Furthermore, CTS promotion in FP mathematics, presents potential benefits that are long-lasting. This is derived from teachers' collective experiences from 5.2.3.1 up to 5.2.3.4, which reveal that developing CTS improves inclusivity in the learning environment, enhances communication and interaction between learners and teachers, which provides openings for guidance that encourages independence and therefore presents the opportunity to improve quality of life.

5.3 CHAPTER SUMMARY

This chapter focused on the current perspectives of teachers regarding the promotion of CTS in FP mathematics, including how these teachers promote CTS and the reasoning behind such enactments. The participant teachers' experiences were expressed through weekly RJ, entries and this data was analysed and interpreted to explore the research questions of this study. The overall findings of the research were informed by a combined theoretical framework (BT, RBT, SC), and were aligned to the presentation of reviewed literature. From this chapter, it was found that CTS is promoted in the FP mathematics classrooms, through multiple methods which aim to provide learners with skills that are valuable in their lives as a whole. The next chapter, presents a discussion of findings and summary of the study, including the conclusions and recommendations for future research.

CHAPTER SIX: DISCUSSIONS AND SUMMARY OF FINDINGS, AND IMPLICATIONS

6.1 INTRODUCTION

The research study sought to explore the promotion of CTS in FP mathematics, concerning itself with the current perspectives of FP mathematics teachers in relation to the promotion of CTS, and also to understand how and why these teachers promote CTS in particular ways, presently.

This concluding chapter delivers a concise overview of each chapter, followed by a discussion of the consequential findings that arose from the study and the related implications as derived from chapter five, the limitations and also the conclusion.

6.2 SUMMARY OF THE STUDY

Chapter One – The research topic was introduced and the need to explore the promotion of CTS in FP mathematics was discussed in 1.2 - 1.4, which was followed by the justification for understanding this phenomenon better. This was indicated in the purpose section (1.5). Furthermore, the research questions, aligned to the study's objectives, were identified and stated. Definitions of the concepts used in the study (promotion, critical thinking skills, foundation phase and mathematics), were provided to produce a generalized understanding amongst readers, prior to stating the significance of this research. Moreover, an overview of the research methodology, methods applied for data generation and analysis, and considerations taken by myself, related to trustworthiness and ethics were discussed.

Chapter two- The main concern was with the theoretical framework adopted by the study. Bloom's Taxonomy (BT) and the latter Revised Bloom's Taxonomy (RBT) were identified and discussed as the guiding framework. The six levels the thinking related to BT and RBT were also explored, together with the sub-component of knowledge generation. Additionally, social constructivism (SC), Socio-Cultural Theory of Cognitive development (SCTCD) and Social Cognitive Theory (SCT) were identified as supporting theories. The relevance and applicability of each theory were discussed in relation to each other and then towards the study as a whole.

Chapter three- A detailed literature review was presented to outline the promotion of CTS in education, in South Africa and internationally. Furthermore, skills related to CT were explained paying attention to the bearing they have on curriculum of FP mathematics. It also

emphasized the relevance and applicability of integrating CTS promotion in FP mathematics, by listing both advantages and disadvantages related to learners' exposure to CTS development, as well as teaching strategies, that influence particularly education and future endeavours

Chapter four – The interpretive paradigm was highlighted as the selected choice for this study. Related implications for this selection were identified and justified. Within this chapter, the qualitative nature pertaining to this research was discussed, together with the narrative methodology, a rich description of the research setting, and sampling techniques applied. It then outlined the participant profiles, reflective journaling as the data generation method, which led to a discussion on the process followed for data generation and the Thematic-Narrative- Analysis (TNA) used to analyse the data. Moreover, concepts surrounding the study's trustworthiness were described in line with credibility, dependability, confirmability and transferability, inclusive of ethical considerations.

Chapter Five- This chapter provided a concentrated view on the presentation of data collected and the analysis of findings which were guided by the study's research questions, as outlined in chapter 1 (1.6). These findings were arranged according to the themes and subthemes identified that emerged from the analysis process of the data collected. An evaluation of the data as organized under themes, was done from the perspective of the theoretical framework (chapter two), relevant literature was reviewed (chapter three), and the research design and methodology (chapter four) were declared.

Chapter six- This final chapter, provided an overview of the study in its entirety, detailing a discussion on research findings as an aligned outcome to the study's research questions and parallel to the objectives. The implications of the study are described, with limitations and finally it provided a conclusion.

6.3 DISCUSSION OF FINDINGS

Emerging findings from the study in relation to the current situation regarding the promotion of CTS in FP mathematics were represented by five themes. Derived from the themes, this study finds that current perspectives are, that CTS must be integrated into the teaching and learning methods of FP mathematics curriculum as stipulated by CAPS. Teachers are initiating the promotion of CTS in such lessons often as a secondary component, albeit with some hindrances caused by limited timeframes, vast amounts of

curriculum and a collective view of requiring training in CTS integration and development. Additionally, findings reveal teachers are promoting CTS in their FP mathematics lessons, by immersing themselves in roles of facilitation, that allows for multiple approaches to guide CTS integration into lessons, together with creating lessons that include varied learning techniques that inspire learner involvement. This study furthermore finds, teachers are promoting CTS in their FP mathematics lessons, because teachers understand that developing CTS provides essential skills that are beneficial to improve learners' quality of life, in present times and in the future.

6.3.1 Teacher awareness of CTS inclusion in FP mathematics and its mitigating factors

In this study, five sub-themes emerged in relation to the current situation of CTS promotion in FP mathematics. Derived from these subthemes, findings revealed that, currently teachers are fully aware and understand that CTS promotion in FP mathematics is compulsory in accordance with the national policy document, CAPS. Adhering to these stipulations, teachers are integrating CTS development into their lessons, although it is implemented as an additional component to lessons. This is due to, constrained time allocations, excessive curriculum demands, and teachers inadequately trained to integrate and conduct lessons that promote CTS successfully as a vital component in education.

A distinct reference that participant teachers made, towards the component of CTS in their created teaching and learning environment, is it is an essential criterion of the CAPS FP mathematics curriculum. Teachers intentionally incorporated CTS in their lessons based on the premise of necessity as deemed by the SA education policy they are guided by. As stated in CAPS, teaching and learning must be conducted in such a way as to create an environment which encourages active learning and develops learners to take a critical approach to their learning (Jojo, 2019; Department of Basic Education, 2011). Moreover, the finding was consistent with the CAPS prerequisite to engage with learners, to solve problems and be decisive using critical thought (Ngozo & Mtantato, 2018; Department of Basic Education, 2018). Due to the mandatory nature of the SA education system and CAPS requirements, teachers are aware of the importance of including CTS in their curriculum and teaching plans.

This finding is however contradictory to findings from Khoza (2016) which indicates that there is a general deficiency in teachers' understanding of the what curriculum goals and

visions are, which presents as a challenge both nationally and internationally when addressing the promotion of CT. Khoza (2016) found that the lack of teachers' understanding results in teachers proceeding to teach learners without being sufficiently informed about the desired outcomes of their subject and overall curriculum.

However, understanding and awareness was apparent from participant teachers, who indicated their acknowledgement of CTS promotion through CAPS, by denoting years of experience in teaching the curriculum, awareness of the stipulated curriculum guidelines and requirements to be fulfilled, through daily teaching, and also referring to advice and curriculum covered during their pre-service education and training curriculum. Additionally, experiences shared in their narrative reflections, showed a generalized compliance with the educational policy, CAPS. Teachers are ensuring that learners are being developed to engage with the outside world, armed with confidence to become knowledgeable critical thinkers of mathematics, as envisioned by the DBE (Petersen, McAuliffe, & Vermeulen, 2017). Teachers showed an understanding of the needs of learners as aligned to the SA education framework, to move learners from traditional rote teaching and given facts, to developing learners with more critical, higher order thinking skills (Jojo, 2019; Omodan, 2019).

Additionally, it was found that CTS is included in FP mathematics lessons, however that it was an additional part of the planned teaching and learning experience. The overall view of teachers was to prioritize the content knowledge based on the curriculum guidelines, and to include CTS as a subsidiary aspect of lessons, to engage with learners. The planning of lessons was done in advance to align with specific subject visions and goals in mind, however there was integration of CTS in the lessons. While the CTS integration was present in certain lessons, it was not implemented in designing of all lessons which should have revolved around teaching learners to think, learn subject content and reach the outlined objectives all the while using CTS, which would have created lessons based on critical inquiry.

A causal factor of CTS taking a backseat to curriculum, instead of prioritized integration, is primarily on the need for concentration on learner achievement and competency in curriculum based and subject content knowledge, due to learner evaluation and assessment being dominantly based on quantitative measures (Care, Kim, Vista, & Anderson, 2018; Jojo, 2019; Omodan, 2019). It is, however aligned with other third world countries and contradictory to first world countries that endeavour to encourage all learners to masters

critical thought (Irawan, Rahardjo, & Sarwanto, 2017)

As instructed through CAPS, CTS is included in multiple lessons of FP mathematics (as stated in 5.2.1.1), however the struggle faced by many teachers, is moving the focus of teaching from being assessment driven with content, to developing the learners as a whole to be aware and critical in the real world (Care, Kim, Vista, & Anderson, 2018). However, a positive facet of this finding, is to note that CTS is definitely included in lessons and promoted with learners in the FP mathematics lessons, and that teachers are aware of CTS being included to enhance the learning environment, as opposed to being completely neglected.

Another reason behind teachers putting CTS promotion into a secondary position in lessons was found to be directly linked to insufficient time allocations in which large amounts of content needed to be taught and assessed. Within the SA educational system, this is a common thread. Schools and teachers alike, are cornered into providing assessment of learners' educational progression through standardized measures, in order to provide proof of the capability of the school to show that learners are attaining outcomes as deemed fit by the national DBE (Mabaso, 2017; Maddock & Maroun, 2018). However, the process of assessment, especially with the subject of mathematics, is based on quantitative measures to demonstrate learners' ability to deal with figures, which is noted to be easier to conduct and is focused on mere rote memorization and requires minimal or absent critical inquiry aspects related to CTS (Nold, 2017; Agoestanto & Sukestiyarno, 2017; Mcpeck, 2016).

It was found that teachers have limited timeframes to complete the curriculum, therefore attempting to focus on the high volume of curriculum content and focusing on CTS as a small component to the lesson, and often required more time to integrate CTS in their lessons effectively due to their day being spent face-to-face with learners all day, reviewing and assessing learners work and also applying different techniques of teaching and learning, to cater for the diverse needs of learners.

It is important to note that teaching involves more than mere reiteration of the curriculum to learners, because a teacher makes contact with learners through face-to-face interaction, as a facilitator of educational needs, a counsellor when needed, a life coach and even a nurse at times (Merritt, 2016). Currently, being a teacher is demanding on time, as many teachers are aware of different teaching techniques to integrate CTS in their teaching and learning plans, however it requires time to implement such plans successfully while considering the diverse needs of learners and appropriately addressing the assessment

frameworks which are focused on content, leaving the development of whole-child (learner) in the background (Care, Kim, Vista, & Anderson, 2018; Green & Condy, 2016) This finding is complimentary to a study by Shernoff, Sinha, Bressler, and Ginsburg (2017) that included both primary and secondary school teachers, which found that teachers focused primarily on content due to a demand on time to perform assessments, which resulted in instruction without creativity or integration with higher order thinking skills. Hence the findings demonstrate, that the focus of instructional time is based on ensuring learners are able to complete standardized assessments, instead of fostering an environment which is based on creative opportunities to integrate and develop CTS.

Both internationally and nationally, the subject of mathematics is considered a portal in the education system that allows learners greater opportunity to enrol at higher education institutions and thereafter attain higher-esteemed careers (Jojo, 2019; Stinson, 2018). Consequently, to achieve an outcome as such, the mathematics teachers who are relied upon for learner achievement, should receive quality training to facilitate learning with high levels of critical thinking in mathematics. As stated in 5.2.1.1 and 5.2.1.2, CTS is an ideal and prerequisite of the guiding CAPS national education structure, and teachers are aware of the need to implement a critical and active learning environment for learners, however numerous teachers have not received formal training on how to integrate CTS into the curriculum content successfully. Therefore, teachers are not competent to integrate CTS as they do not know where in the curriculum CTS would fit in best or how to access and apply quality teaching resources, resulting in poor application of the appropriate teaching techniques (Zulfiqar, 2018; Halabi, 2018)

Moreover, findings revealed that, implementation and integration of CTS is not viewed as an easy task for teachers and they are often placed in positions where they have to elect to focus on traditional conceptual knowledge building, rather than whole-learner development. Referring to 5.2.1.4, participant teachers shared experiences, that illuminated their uncertainties on how to proceed with lessons, and how to further integrate or re-design lessons to get better outcomes in relation to the promotion of CTS. Future guidance was also mentioned in terms of additional supervision from Heads of Departments or collaborative activities with fellow FP mathematics teachers. This resonates positively with findings from Maharajh, Nkosi, and Mkhize (2016) and Shernoff, Sinha, Bressler, and Ginsburg (2017) that found that teachers are often exasperated with the demands of the curriculum, without clear directives as to how these changes and ideals are to be implemented, while lacking

the technical skills to carry out the tasks asked of them. The study went on to state that even with the learner-centred CAPS, teachers are insufficiently trained to carry out the tasks as demanded by the DBE.

Therefore, when teachers feel incompetent to carry out tasks efficiently, it can create concerns, which can inadvertently result in teachers choosing to add or omit curriculum concepts or to select educational policy goals, to suit their skillsets (Green & Condy, 2016; Khoza, 2016). It was found, in this study that teachers were requesting assistance to ensure that CTS integration could be achieved more successfully, in order to provide an effective mathematics foundation for learners. Teachers need explicit training to plan, design and perform the desired CT teaching techniques, to create a culture of CT amongst learners (Nold, 2017; Pols, 2019).

Teachers realised that CT is a skill needed by all, and developing such skills at an early age can provide opportunities for young learners to gain more experience and practice that can help determine how efficient learners will be when using and applying such skills. Knowledge about almost everything is available at the click of a button in this era, from search engines available on the majority of digital and technological devices (Erstad, 2018; Forth, 2019). However, access to information does not guarantee comprehension, interpretation and evaluation of trustworthiness, especially with the vast amount of incorrect information obtainable (Carbogim, et al., 2019; Martinelli, 2018). Additionally, the expressed view is that CTS can be used in life after the school experience is over, which is also a finding from Nold (2017), saying CTS development goes beyond the classroom and into adulthood as well.

Articles by Hitchcock (2018) and Rymanowics (2016) have discussed similar views, that learners armed with CTS are more independent and confident in their approach to education, and often take on a more responsible and self-directed route toward their own learning. The presence of CTS in learners, therefore encourages personal evaluations of their own strengths and weaknesses, interpreting and analysing information from multiple disciplines to solve the problems at hand and even in real-life situations out of the school environment (Nilson, 2018; Mabaso, 2017). Within the classroom, learners who demonstrate CTS, are able to solve mathematics problems by reading between the lines, therefore building more meaningful conceptual knowledge (Halton, 2019; Mcpeck, 2016), hence the development of CTS as viewed by the participant teachers, can be regarded as an asset in the classroom and beyond.

Teachers in this study understood that CTS is an asset for learners and starting as early as possible in the FP years of mathematics, can only insert skills that have longer periods of time to develop, so learners may become masters of such a skillset in progressing years. This finding is aligned to advantages of CTS as mentioned in chapter three, which indicated that CTS encourages understanding and retention of knowledge and quick thinking capabilities in mathematical computations, to improve academic success in schooling education and later on at higher education facilities.

From the examination of sub-themes 5.2.1.1-5.1.2.5, the current situation regarding the promotion of CTS in FP mathematics as derived from participant teachers' narrative reflections, reveal findings that, teachers are currently aware of the need to implement and integrate CTS in their FP mathematics lessons. CAPS requirements are being fulfilled through components of CTS being assimilated into the curriculum content. Even though the presence of CTS in lessons, is not dominant, teachers are cognizant of the potential asset CTS can be in learners' lives. CTS promotion can have prospective improvement, with additional professional development and training provided to teachers, so they may be better equipped to plan and deliver lessons that are based on critical inquiry.

6.3.2 The promotion of CTS in teaching and learning in FP mathematics

The enactment of CTS in FP mathematics is confirmed through this study. Upon examination of the data, a general theme surrounding CTS inclusion in teaching and learning was established. This further lead to the development of sub-themes, which discovered findings of CTS promotion being conducted by teachers using multifaceted approaches to ensure the integration of CTS into their lessons, encouraging learners to engage with CT through varied learning techniques and moreover, the teacher transforming into a role of facilitator

According to the findings of this study, teachers used multiple approaches to incorporate CTS within their FP mathematics lessons. Experiences from teachers' reflections indicated, that teachers are promoting CTS by showing learner's multiple approaches to solving mathematical problems, so learners have access to understanding and applying different methods when addressing mathematics in future lessons. Also, used in teaching, was a reward system that contributed to getting learners motivated to participate in CT activities. Furthermore, specific vocabulary was used to encourage learners to engage in critical

thought, and this vocabulary was additionally integrated with open-ended questioning, to entice learners to think about answers before, providing answers. Other approaches used, were pausing to give learners adequate time to reflect and evaluate their thoughts and those of others, and also waiting on learners for ques to provide guidance and support. Moreover, teachers related lessons to real- life, so learners could understand situations that required CT.

The approaches applied to lessons by teachers in the study, were closely linked to BT and RBT as discussed in chapter two (2.3 and 2.4), expressing the need for learners to be engaged in learning that moves from lower order thinking, up to higher order CT. Hence, teachers should construct opportunities for learners to develop CTS and thereby initiate and maintain a classroom culture based on CT, which is actively engaged by both teachers and learners (Joseph, 2019; Zulfiqar, 2018). By introducing and preserving a CT environment, there is an unspoken demand for learners to practice CTS, to refute rote teaching and to develop thinking that instigates questioning and awareness related to reasoning (Nilson, 2018; Stauffer, 2020).

The findings from this study, are validated by research done by Chikiwa and Schafer (2018) that established that the use of multiple teaching techniques is beneficial to addressing diverse learner needs and in developing CTS, which particularly motivated that questioning at the correct levels of cognition, as a direct impact of developing CTS in mathematics. Additionally, questions provide an avenue for focusing on thinking and demands information to gain understanding, therefore the priority of the lesson relies on improving CT and less on only generating solutions, which opens the doors for discussion, simulation and debate (Joseph, 2019). Further, in the teaching and learning process, the use of specific vocabulary can either halt participation and thinking or enhance it. Participants, concluded that the use of appropriate words and offering rewards for participation, regardless of incorrect answers, gained learner involvement in critical thought. Moreover, teachers providing clues, directed learners to think more deeply, abstractly and actively to have more control over the learning that would take place.

Another aspect of the enactment of CTS promotion was found to be evolving around learner engagement through a variation of learning techniques. The findings revealed that lessons involving collaborative work, investigative or active learning techniques, were successful in the promotion of CTS. Providing collaborative and active learning environments helped learners to practice CTS and become aware of the benefits of working with others, helping

others and also to become confident in their individual abilities to move past memorization in learning and taking paths that offer deeper critical learning. The teacher's responsibility is to enable this learning and to provide opportunities that entail collaborative, active and investigative activities.

Findings derived from the analysis of participant teachers shared experiences, showed that teachers used activities that deliberately grouped learners for specific lessons to ensure that learner with stronger mathematical abilities could work with learners that required more practice with their CTS development, and also as a means to share knowledge and expertise on specific learning styles. Additionally, teachers understood that working with mixed ability and diverse groups, allowed for communicative exchanges, both verbal and behavioural, that encouraged learners to engage in metacognitive processes (Chapter two – 2.6), and to evaluate thoughts of others before responding

This study found that the social interactions resulting from group work, are in line with concepts of social constructivism, which demonstrates that learning happens in a social environment and from others such as peers or teachers (Iba & Burgoyne, 2019; Taylor, 2018). Collaborative learning, is an aspect of SCTCD and SCT (chapter 2- 2.8.1 and 2.8.2), meaning that learning occurs through social interactive exchanges between learners of different abilities and through positive adaptive behavioural interchanges. Therefore, when learners engage in collaborative activities, it creates an involvement of different thinking, sharing of knowledge, a mingling of interpersonal views, a development of respect and understanding of others and helping others to improve themselves. (Omodan, 2019; Sumarna, Wahyudin, & Herman, 2017). Also, working in groups, with mixed abilities and preferences for different learning techniques, helps learners to learn different methods of solving mathematical problems from their peers and more abled learners offer a scaffolding for weaker learners to achieve goals, who in other situations could fall behind.

Moreover, active learning was teamed with activities that promote investigation, uncover new ways for learners to surpass rote teaching or memory of theory, but rather discover the multiple truths that are available, through identification, interpretation, problem-solving, and evaluation by applying CT (Department of Basic Education, 2018; Jojo, 2019). Learning through active methods, does not rely on just retrieving or on reciting of information but requires learners to use analysis and CT (Nold, 2017). Furthermore,

teachers who use active learning activities, create an exciting, interesting and interactive environment, encouraging learners interest to peak, and to improve their attitudes towards participation (Jagtap, 2016).

It was revealed that teachers provided opportunities for learners to indulge in activities that required both individual and group investigations to solve and understand problems. Learners were given opportunities to experiment with methods and to find solutions that were created from active engagement in the classroom and school environment and also by actively accessing and practicing CT lessons that were presented to extract excitement from learners and that promoted voluntary participation, that was not solely reliant on teacher's instruction and input Active investigation as a method of teaching, can also appeal to learners who prefer to learn through more creative methods. Learners who prefer creative, active learning, may be restricted with conformed classroom learning and teaching, and when given the opportunity to become actively involved in CT can provide profound perception which enhances their learning (Kronenberg, 2019). As described by Kronenberg (2019), Joseph (2019) and Martinelli (2018), with the correct stimulation matched with diverse learning techniques, learners have a chance to shine, allowing CTS development and practice to take place with ease.

According to the findings, teachers also took on the role of facilitator in lessons. Within the realms of education, a teacher who moves past the traditional roles of prioritizing conventional lesson dominance based on instruction that stresses conceptual knowledge, into a position of support, ideally engages in facilitation (Keiler, 2018; Lewis, 2016). When teachers take on the role of facilitator, they provide planning and support, in order for learners to investigate and to learn actively with the help and freedom to express themselves (Tout, 2016). Learners spend most of their day in the presence of the teachers, and this allows teachers to gain a firm understanding of learner qualities, which provides teachers with opportune chances of planning for their specific learner needs and knowing when and how to give support and guidance (Jagtap, 2016). Hence, as a facilitator, teachers are available to learners and can assist in developing CTS in learners by amending plans and strategies for learning to occur.

Sentiments shared from participant teachers expressed the view that facilitation was rewarding for both learners and teachers alike. Learners were given freedom to define their learning and take ownership of fulfilling outcomes at their own speed and through their

own process of discovery. Lessons were created around situations that created interest in learners, which in turn inspired participation and led to more significant CTS being applied to engage in the exercises and within group work activities. In some cases, teachers in the role of facilitators, found that when learners were given more independence to find solutions using personal pace, thought and process, some learners had surpassed even the teacher's expectations of performance outcomes. Furthermore, it was found that some learners work better without pressure from teacher's instructions, creating a more relaxed learning atmosphere that encourages learner involvement.

This echoes sentiments from studies done by Sanders (2016) and Jagtap (2016) asserting that when teachers become facilitators and create lessons that indulge in learner investigation and discovery, lessons become imbued with CTS and they elicit willing participation and are often more memorable for learners. As facilitators, these teachers determine the appropriate time to extend intervention measures, contend with learner resistance and administer changes to the lessons accordingly, provide shifts in direction of imperatives, and create an openness for discussions and questions (Keiler, 2018; Tout, 2016). In order to gain the true potential of lessons and learner CTS development fully, teachers should still teach with content and instruction, but offer learners opportunities to become autonomous in their learning (Khalaf, 2018; Lewis, 2016), as teachers facilitate learner growth and learning through support, care, advice and direction (Jagtap, 2016).

The findings therefore reveal, that teachers use multiple approaches that encourage CTS promotion in the FP mathematics lessons. Teacher approaches are modified and used interchangeably, to tend to learner needs. In accordance with these approaches, teachers integrate lesson content with different learning techniques, which appeal to the diverse learners in the classroom. These techniques create opportunities for learners to investigate concepts, methods and practice their CTS actively through different ways, which also enable both social learning and individual recognition of strengths and assist with improving on weak points. Facilitation is also a method of CTS promotion being used, as it stimulates independence, self- evaluation, inter-communicative thought and resonates with retention of skills and content knowledge.

6.3.3 Extended benefits of CTS promotion in FP mathematics

In accordance with the way in which CTS promotion is being done in FP mathematics, the

study found that there are multiple benefits to the learners' development of CTS. The findings showed that learners can become more understanding and accommodative towards others, creating a learning environment that is inclusive and providing learners with skills that instil thoughts of inclusivity in future interactions. Additionally, the study showed that CTS development in FP years through mathematics, can enhance communication and interactions in any relationship and guidance from facilitative activities create a pathway for learners to become independent individuals and thereafter the quality of lives of learners will be improved.

In accordance with inclusivity, it is beneficial to provide learners with experiences in the classroom, that allows learners to express their diversity, share knowledge with each other and indulge in learning that inspires and excites them (Razeek, 2020). This can be achieved through the creation of lessons that allow learners to explore, express and learn genuinely. Teachers who provide activities that promote CTS embedded in inclusive teaching, enhance learner engagement, promote a love for learning in learners and often find that the resultant effects of the lessons are positive (Shulman, 2018). In this regard, teachers are responsible for finding ways to tackle the disparate groups of learners when teaching CTS. All learners must be given opportunities to achieve goals and teachers should provide learning that caters to learners who learn differently in terms of techniques and timeframes (Palevich, 2020; Misra, 2020; Department of Basic Education, 2011) Moreover, learners often understand similar concepts in different ways, and partnering encourages learners to share knowledge and understanding of different techniques. It can therefore expand learners' portfolio of techniques when they learn from others. All learners, regardless of strengths or weaknesses can benefit from activities that are based on inclusive approaches

Findings revealed that teachers often used group work to encourage a mix of diversity in lessons, that allowed learners to help and learn from each other. Through such activities, learners were also able to share new and different perspectives of the same or similar topics, to broaden their view of the world and of the people around them. Moreover, groups were created to incorporate different abilities, and to include learners who preferred independence and those that required assistance, so each could thrive with the others. Teachers also amended lesson plans according to different learner abilities, so that all learners were involved and their needs were catered for. Moreover, teachers included lessons that appealed to learners who preferred theoretical instruction and to those that relied on practical active learning (chapter six - 6.3.2) to engage learners different learning styles.

When teachers create a foreground for inclusivity as expressed by participants in this study, the path for development can easily be followed. CTS that are taught can always be improved upon, therefore teachers who cater for inclusivity in the classroom, develop learners who are ready to help others and those who are not afraid to learn from others, creating humans that understand that learning is not merely from books, but can be achieved from those around us (Gupta, 2016; Anghie, 2020; Care, Kim, Vista, & Anderson, 2018). This in turn, develops individuals who are not afraid to ask for help when needed. From these findings, teachers planning of lessons showed that, collaboration is ideal to indulge in different thought, ideas and therefore different solutions in the mathematics classroom (Palevich, 2020; Hitchcock, 2018). When learners understand that there is more than one solution or method to solve problems, they will address new problems differently, by applying deeper critical thought, especially if their initial methods do not provide adequate results. Additionally, with the continuous participation in inclusive activities, learners will develop a confidence to participate and voice their opinions together with sufficient supporting explanations (Razeek, 2020).

Further findings where in relation to enhanced communication and interactions. CT has been found to have a great influence on improving communication skills, which in turn creates a positive foundation for maintaining positive interpersonal relationships (Joseph, 2019). When learners are given openings to provide explanations for their way of thinking, communication becomes a part of the learning experience. During teaching time in the classroom, learners can express themselves by communicating how they view, think and solve problems, in order for other learners and the teacher to understand the process taken by the learner. This not only enhances the probability of using CTS in each step further surpasses learning for solutions only. Additionally, applying CTS in communication is beneficial and can be used daily, to provide reasoning through problem-solving, developing convincing arguments and establishing substantial explanations (Miller, 2020). When an individual is confident and equipped with thinking based in CTS, they are able to consider multiple -perspectives, to examine the thinking processes of others and then to responding justly and they do not overtly resort to responses based on emotions (Doyle, 2019; Johannsen, 2019). In this way, CTS influences communication to create positive relationships between co-workers, family, friends and romantic relationships.

Findings derived from narrative reflections indicated by teachers, showed that teachers view CTS development as a cornerstone to improved communication, which in turn

improves the quality of interactions learners may have with others in the classroom and beyond in future years. Working in collaborative exercises, promotes CT that has consideration for the thoughts, backgrounds, emotions and influence of others' perspectives. Learners become practiced users of CT, to communicate after understanding, evaluating and imparting metacognitive processes. Moreover, learners become more skilled at listening to understand, to consider opinions that conflict with their personal views and expand their thinking to accommodate thoughts of others without losing their individuality. From these reflections, teachers do recognize a link between communication and CTS, and show an understanding of how one affects the other.

Therefore, if activities are created based on communicative aspects in a collaborative setting, learners have to learn to verbalize their thinking in order for others to understand their train of thought, and further communication between learners helps them to co-create analysis and interpretation of information to achieve a solution (Hajhoseini, Zandi, Shabanan, & Madani, 2016; Mcpeck, 2016). When communication is required between one or more individuals, there is a movement of information. The sender of information needs to apply critical thought before choosing words or actions to convey his/her message, in order to be conscious of the selection of words, implications and other's perspectives, and in turn the receiver of such information must also consider these elements and possibly also respond in a manner that is not emotionally-loaded. They interpret the thinking processes of the sender and are able to respond in a reasonable amount of time (Johannsen, 2019). All of which reverberates with the skills associated with CT.

Most problems or breaks in communication are as a result of poor CTS being applied in the communicative process. CTS implemented early in education, in the FP years, can improve communication and improve problem-solving when such breaks occur, in order to rectify the situation. Moreover, learners who are more proficient with CTS and have more practice with CTS, tend to be better communicators in all aspects of life (Sanders, 2016; Hitchcock, 2018)

The aspect of guidance which leads to learner independence was also found from this study. Teachers who immerse themselves in facilitating roles enable learners to have support to achieve success, build confidence and become well-informed individuals who are more adept at becoming independent and responsible adults (Sanders, 2016). Hence teachers are

responsible for developing learners who are able independently to think critically about the world, make informed evaluations, and make decisions that are supported with information that has been analysed, and decided upon as the best option (Tout, 2016; Joseph, 2019). Developing independent learners stems from strong CTS, that are encouraged through lessons that progress to less structure and towards open activities that slowly reduces support (Nilson, 2018; Hajhoseini, Zandi, Shabanan, & Madani, 2016). Teachers may choose to offer scaffolding only when deemed necessary and select tasks that require independent CT that may start in small segments succeeding to larger projects over time (Sieck, 2020; Shulman, 2018).

Teachers from the study, discussed experiences about renouncing the position of instructor in the classroom, to assume the role of facilitator in order to inspire learners to take on roles that demonstrate independence. When teachers become facilitators, learners are forced to think for themselves, engage in activities to understand, therefore imparting control of the learning experience to learners. Teachers reported positive outcomes from CTS promotion in their lessons, because learners who became more confident in their own thinking abilities, required fewer teacher interventions to solve problems. Teachers also reflected on open-ended discussions that sparked learners thinking, whereby learners discussed problems and fed of each other's thinking to improve their own understanding. These narrative reflections showed that with more CTS being developed in learners, the dependence on teacher instruction was reduced and instead learners requested guidance on their own terms.

Moving beyond the classroom and firm reliance on teacher instructions, independent thinkers, become more reliant on themselves to learn, through weighing up their own strengths and limitations and finding new techniques that address such elements, in order to own their education (Hitchcock, 2018). Learners are able to think critically and independently about mathematics from different viewpoints and find new understanding of mathematical concepts on their own, to find that mathematics is all around them. Developing independence from a CT foundation offers young learners with a loaded potential to become thinkers who are independent and are able to provide a redefined view of the word around them (Sieck, 2020).

Upon further examination, the study found that CTS promotion is often implemented in FP mathematics because it has multiple long-term benefits. Individuals who are proficient in

using critical thought in different situations tend to make better life decisions, differentiate between authentic and misguided information, have abilities that create better opportunities for employment, work well in teams, are more efficient in dealing with money matters, evaluate consequences of their actions, to name a few, advantages, creating more stability and security in their lives (Anghie, 2020; Sieck, 2020; Rymanowics, 2016). Moreover, in a world dominated by technology, learners who have strong CTS, become assets to themselves and the world, through enhanced communication, abilities viewing the world as having multiple possibilities, taking more ethical stances, and avoiding to focus on limitations of themselves and others, creating an attitude of positivity (Doyle, 2019; Tout, 2016; Stinson, 2018; Halabi, 2018). These effects of CTS development offer both young and old, benefits that can stand the test of time.

From the study, teachers presented reflective experiences which directed their teaching. Teachers realized that integration of CTS within their FP mathematics lessons, would encourage learners to develop and improve on their skillsets, to understand, communicate, and become confident and informed individuals. Moreover, teachers shared views on learners taking routes of personal discovery to identify who they are amongst others, to identity their uniqueness and therefore reduce situations that are influenced by others. Additionally, learners would develop into individuals who are not convinced with arguments without support, thereby, they become seekers of information to create their own personal view that is justified with clear and well- researched data. Furthermore, learners would take on a more open-minded approach to life and not be confined to specific thoughts, but rather use all experiences to broaden their outlook on life. Teachers advised that from their experiences, early CTS integration from the FP mathematics lessons, could ensure that learners use CT and exhibit resilient skills that could enhance the lives of learners, in relationships, career, academics and finances.

Similarly, when learners become more understanding of different views it allows for acceptance of others thoughts, and lays a foundation for accepting advice from others, whereas self-awareness means the learner can develop as an individual to become a refined whole person (Stauffer, 2020; Tout, 2016). Moreover, when learners think critical they are more inclined to interpret educational content with deeper understanding, increasing academic success, which in turn improves possibilities of acceptance at higher education facilities and thereafter higher probability of securing employment (Doyle, 2020; Forth, 2019; Zulfiqar, 2018). Moreover, learners become equipped to create their own beliefs and

values based on multiple aspects of CT, becoming confident to listen to alternative perspectives, amending personal principles and still honing their own individuality and voice which are considered good predictors of success (Sieck, 2020; Palevich, 2020).

Hence, the early integration of CTS promotion in FP mathematics is done with intention of laying the groundwork that is advantageous for learners' CT development. Learners who are inclined to use CTS from a young age, are more adept to applying it, in everyday life, and therefore have more potential to have lives which are more fulfilled and of a higher quality. These learners are not fazed by controversy and adversity, because they have a developed critical thinking capacity to evaluate and respond to situations effectively and efficiently. Teachers understand the benefits consequential to CTS promotion in FP mathematics. These benefits are limitless in expanding the calibre of life that learners could and should have.

6.4 IMPLICATIONS

As stated in chapter one (1.5.1), the prime purpose of the study was to understand the promotion of CTS in FP mathematics. However, the findings provided a deeper insight and an overall awareness of how and why CTS promotion is beneficial to learners, hence early introduction and practice with CTS in FP mathematics is vital. Furthermore, these findings can be useful to the DBE in future curriculum planning, and to higher education institutions who train future teachers, but can also create a broadened perspective for practicing teachers, school management teams and for our young learners. Participating teachers could show newfound awareness and appreciation of CTS development in their FP mathematics classes and reconsider their future teaching styles and planning of lessons to integrate CTS deliberately, but also to share these considerations with fellow colleagues, prompting potential positive change in other teachers. Hopefully, this study can provide a new perspective on CTS promotion, through an extension of knowledge, that can be referred to by education policy makers and by future researchers, to generate deeper understanding. Ultimately, all children have a right to education and since one of the goals of education today, is to develop learners to become critical thinkers (Mcpeck, 2016), the prime outcome would be that this study influences more individuals to actively promote CTS in FP mathematics, so that more learners can be equipped with such skills.

After evaluation of the study, I would recommend that the DBE, teacher development and

training sector (including pre-service teacher training at higher institutions) together with school management teams, implement the following:

- Provide teacher training that contributes to teacher confidence in redesigning the curriculum to provide better integration of CTS promotion in FP mathematics, so that lessons are created to be centered on teaching curriculum content through critical inquiry from as early as possible so that it becomes the new normal.
- Ensuring teachers have sound knowledge on CTS and ways to improve CTS development. The relevant stakeholders should provide guidance to teachers on new approaches to promote CTS and to supply the necessary resources accordingly.
- DBE representatives should be regular visitors at schools, to evaluate each school environment and its conduciveness to CTS promotion, including the classrooms, teacher profiles, and learner needs. Thereafter, changes can be advised to school management teams and follow up visits should be scheduled to verify if instructions have been adhered to.
- Teacher development and training should occur regularly and should be guided by education specialists through a structured and organized programme. These workshops should be calendared, so teachers are prepared and can note down areas of concern or those requiring reiteration and assistance, prior to training dates.
- Learner assessment regimes can be amended to include active or investigative learning methods, rather than quantitative methods only. Some learners understand concepts but find difficulty in expressing themselves in traditional assessment formats and settings. Hence to accommodate diversity and various learning styles, assessment should be in line with learner needs.
- Reworking of time frames allocated for curriculum coverage and assessment. Teachers often feel overwhelmed and pressurized to complete content aligned to CAPS, which results in selection of easier time-saving activities, rather than those that stimulate CTS development.

I acknowledge this study was done within a specific research setting and participants selected on convenience criteria, and consequently the findings are exclusively related to the selected institution used for the study and generalization cannot be effected. Furthermore, the findings could have differed if conducted at another institution, use of more participants or if the focus was on a specific grade in FP. Therefore, my

recommendations for future research, would be to conduct a similar study which includes more than one research site and includes larger participant selection, which will extend the data generation across multiple FP mathematics classrooms. The future research could also focus more on ways to enhance the promotion CTS in FP mathematics.

6.5 LIMITATIONS OF THE STUDY

The limitations of this study, were identified as follows:

- The research was conducted at one specific primary school, within Durban in KwaZulu-Natal, and the sample size was limited to the institution, resulting in findings that cannot be generalized;
- As the researcher, I am currently a member of staff at the institution, in which the study was conducted. Due to my working relationship with participants, narrative reflections could have been influenced by my position and association with participants, as colleagues; this was counteracted by encouraging honesty and anonymity to create an open and safe portal for participants to freely relay their subjective experiences through personal journals, which were completed in private.
- The data generation was done during the Covid-19 lockdown in South Africa. Hence participants were contacted telephonically and by email. It proved to be a hindrance with regard to explaining aspects of the study. To resolve this, I had to phone participants multiple times to clarify any confusion;
- One participant exited the study after two months of consenting to participate (No data was generated from this participant at the time). The data generation process was therefore halted, until a new participant was found as a replacement. The new participant was contacted telephonically to discuss the details of the research and all ethical considerations were explained. Thereafter the consent form was emailed to the participant, followed by the data generation RJ. The exiting of the participant, resulted in a total of approximately three months' delay (the two months that passed while the participant was a part of the study and an additional month for the new participant to complete the RJ).
- The data generation relied solely on narrative reflections through the RJ. The findings of the study could have been different if additional data generation methods had been used to substantiate the RJ.

- I am a new researcher and therefore I lack experience in conducting research and constructing academic papers. The scope of discussions and depth may therefore be compromised in this study, in relation to other scholars.

6.6 CONCLUSIONS

The study proposed to explore and understand the promotion of CTS in FP mathematics, by using teachers' narrative reflections through reflective journaling. The study showed that teachers understand the importance and value of promoting CTS in their FP mathematics lessons, and also that teachers are aware of the CTS development being a prerequisite of CAPS. In order to integrate CTS promotion, teachers are using multiple approaches to teaching, and including various learning techniques that enhance learners' practice and participation in CTS development. Teachers are also changing their roles from instructor to facilitator, to create opportunities for learners to take the lead in their education and to develop independence. Moreover, the study showed that teachers are intentionally promoting CTS in their FP mathematics lessons, because they understand that learners can profit from several long-term benefits of CTS, which would improve learners' quality of life. The study also recommended that all stakeholders involved in FP education contribute to teacher skills development, to ensure teachers are given additional training so that promotion of CTS can be enhanced and the learning environment or conditions created are conducive for learners to practice their CTS. It is hoped, that the findings, suggestions and perspective offered by this study, provides new insight and understanding of the promotion of CTS in FP mathematics.

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APPENDIX A

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma/Buyi Ntuli | Tel: 033 392 1063/51 | Ref.:2/4/8/4080

Mrs Leeandri Kunniah-Ruttu
195 Viewhaven Drive
Woodview
PHOENIX
4068

Dear Mrs Kunniah-Ruttu

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"PROMOTING CRITICAL THINKING SKILLS IN FOUNDATION PHASE MATHEMATICS"**, 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 26 February 2020 to 10 January 2022.
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/Mrs Buyi Ntuli at the contact numbers above.
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.

[redacted]

Dr. EV Nzama
Head of Department: Education
Date: 26 February 2020

...Leading Social Compact and Economic Emancipation
Through a Revolutionary Education for all...

KWAZULU-NATAL DEPARTMENT OF EDUCATION
Postal Address: Private Bag X9137 • Pietermaritzburg • 3200 • Republic of South Africa
Physical Address: 228 Pietermaritz Street • Ex-NED Building • Pietermaritzburg • 3201
Tel.: +27 33 3921063 • **Fax.:** +27 033 3921203• **Email:** Phindile.duma@kzndoe.gov.za •**Web:**www.kzneducation.gov.za
Facebook: KZNDOE....**Twitter:** @DBE_KZN....**Instagram:** kzn_education....**Youtube:**kzndoe

APPENDIX B

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

08 April 2020

Mrs Leeandri Kunniah-Ruttu (206503407)
School of Education
Edgewood Campus

Dear Mrs Kunniah-Ruttu,

Protocol reference number: HSSREC/00001158/2020
Project title: Promoting critical thinking skills in foundation phase mathematics
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 16 March 2020 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 08 April 2021.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane J Hlalele (Chair)

/ms

Humanities & Social Sciences Research Ethics Committee
UKZN Research Ethics Office Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Tel: +27 31 260 8350 / 4557 / 3587
Website: http://research.ukzn.ac.za/Research-Ethics/

APPENDIX C

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

APPLICATION FOR ETHICS APPROVAL
For research with human participants

INFORMED CONSENT RESOURCE TEMPLATE

Information Sheet and Consent to Participate in Research

Date: 10 February

2020 Dear

Colleague

My name is Leeandri Kunniah-Ruttu. I am a Master of Education student at, the University of Kwazulu-Natal, Edgewood campus, School of Education (Contact Number: 0785643782; Email: leeandri.k@gmail.com/206503407@stu.ukzn.ac.za)

You are being invited to consider participating in a study that involves research about promoting critical thinking skills in foundation phase mathematics.

What is the study about?
The aim and purpose of this research is to explore the current situation of critical thinking skills in foundation phase mathematics teaching, and to understand how critical thinking skills are being promoted in the foundation phase mathematics. This study will also explore why the promotion of critical thinking skills is being done the way it is currently, in your mathematics lessons.

Who will participate?
The study is expected to enrol a total of 3 participants from your school, all being foundation phase mathematics teachers. There will be one teacher from grade 1, one teacher from grade 2 and one teacher from grade 3 selected for participation.

Study protocol
If you agree to participate in this study, the following procedures will take place. A time slot which is convenient for you and the researcher will be chosen, in which an interview will be conducted. The interview will entail questions about your experiences and teaching of critical thinking skills in foundation phase mathematics. Likewise, questions will relate to the skills you encourage in your lessons and how you integrate them into your lessons. This interview will be recorded on interview schedules and notes will be made by the researcher. The duration of your participation if you choose to enrol and remain in the study is expected to be, one day in which an interview of approximately one hour, will be conducted.

Funding of the study
The study is funded by myself, Leeandri Kunniah-Ruttu.

Benefits of participation in this study

This research study does not have a direct benefit to you, as a participant. However, the information provided by the study may help researchers gain a better understanding of critical thinking skills in foundation phase mathematics. Participation in this study, can offer you an opportunity to reflect on your experiences as a foundation phase mathematics teacher.

Risks of participation in this study

Participation in this does not involve any physical or emotional risks, other than that of everyday life. Although, you may experience fatigue or possible stress during the interview process, when responding to questions. If such fatigue or stress may occur, ample breaks will be provided during the interviewing sessions.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number: HSSREC/00001158/2020).

Contact details for any questions or concerns

In the event of any problems or concerns/questions you may contact the researcher at: Cell phone: 0785643782/ Email: leeandri.k@gmail.com or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION
Research Office, Westville
Campus Govan Mbeki
Building
Private Bag
X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557- Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

Your rights as a participant

Participation in this study is based on voluntary participation. Participants wishing to withdraw from this study can and may do so at any given time, by emailing myself Leeandri Kunniah- Ruttu, stating your wish to withdraw. Upon receiving the email, the participants request to withdraw from this study will be honoured with immediate effect, with no consequences.
The researcher can terminate teacher participation from this study, if after 3 failed attempts to make contact with participant or participant has limited availability to participate in the study.

Costs and Reimbursements

Participation in this study does not incur any costs to the participants and therefore no reimbursement for participation and/or other expenses will be provided.

Participant confidentiality and data storage/disposal

Anonymity of participants will be maintained, by having no identifying questions pertaining to name, surname or name of school included in the interview process. All participants will be given pseudonyms which will be used throughout the write-up process. All data collected will be stored in a password encrypted document in a password protected computer, with limited access, available only to the researcher and

the supervisor. After a period of 5 years, all data will be deleted off both the researcher's and supervisor's computers and recycle bins will be emptied. No alternative copies of data will be reproduced thereafter.

CONSENT (Edit as required)

I (Name) have been informed about the study entitled *Promoting critical thinking skills in foundation phase mathematics* by Leeandri Kunniah-Ruttu.

I understand the purpose and procedures of the study.

I have been given an opportunity to answer questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without any consequences.

I have been informed about no reimbursements for participation and/or other costs.

If I have any further questions/concerns or queries related to the study, I understand that I may contact the researcher at – cell:078 564 3782 or email: leeandri.k@gmail.com.

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION
Research Office, Westville
Campus Govan Mbeki
Building
Private Bag X
54001 Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557 - Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

Additional consent, where

applicable I hereby provide

consent to:

Audio-record my interview / focus group discussion YES / NO

_____ _____

Signature of Participant **Date**

_____ _____

Signature of Witness **Date (Where applicable)**

_____ _____

Signature of Translator **Date (Where applicable)**

APPENDIX D

I, Leeandri Kunniah-Ruttu, a MEd student at the University of KwaZulu-Natal, request authorisation to conduct research at Brookdale Primary School. It is intended that the research will be conducted in only one school.

The proposed research title is: **Promoting critical thinking skills in foundation phase mathematics**

The focus of this research is to explore the current situation of critical thinking skills in foundation phase mathematics teaching, and to understand how critical thinking skills are being promoted in the foundation phase mathematics. This study will also explore why the promotion of critical thinking skills is being undertaken in the manner in which it is being effected currently, in your mathematics lessons.

The Research questions are:

2. What is the current situation regarding the promotion of critical thinking skills in foundation phase mathematics?
3. How is this promotion of critical thinking skills being effected in foundation phase mathematics?
4. Why are critical thinking skills in foundation phase mathematics being promoted the way that they are?

The intention of the study is to engage with a purposively sampled group of teachers, who work at Brookdale Primary School. Upon approval from your office, teachers will be contacted and briefed about the aims and purpose of this research study. Reflective journals will be used during the data collection process.

Weekly Reflective Journals

Critical thinking, can be defined as the intellectual process of actively and skilfully conceptualizing, applying, analysing and synthesizing and/or evaluating information, produced by observation, experience, reflection, cognitive reasoning or verbal debate. Therefore, critical thinking is predominantly about making complex decisions and being able to defend one's point of view. If critical thinking is engaged in, then one may identify and ask significant questions actively, and then critically evaluate and provide a reflection on their course of work and similarly on the work of others.

Key notes:

- There are no right or wrong answers. Therefore, please feel free to express your ideas, opinions and thoughts.
- Do not hesitate to share your personal experiences to illustrate your points of view.
- Do not limit yourself to words only- diagrams and pictures can be used.
- Do not feel restricted to space or word counts. Write freely and honestly.

Week 1 Reflection:

The promotion of:

Problem Identification and Analysis – the problem or main point is identified, and the ability to gather and process information and knowledge, to break up the problem into its component parts

Interpretation - concluding what meaning the processed information suggests.

Drawing from your experiences this week, please elaborate on how you plan to integrate problem identification and interpretation into your lessons.

Which planned experiences went well when promoting these skills?

Think about your intentional teaching of these skills.

Discuss other experiences that took place which were not on your planned programme for the week.

Thinking about *problem identification and analysis;* and *interpretation*, what do you consider needs to be followed up on and why?

How would you go about extending these skills for your future lessons, providing possible changes and a rationale for them?

Week 2 Reflection:

The promotion of:

Inference – assessing whether the knowledge you have is sufficient and reliable or not

and ensuring your conclusions are being supported by the best evidence

Evaluation – the ability to make decisions based on the information you have available and going over the same information to ensure that nothing has been overlooked.

Explanation – communicating your findings and being able to provide clear reasoning with elaboration or supposition

Drawing from your experiences this week, please elaborate on how you plan to integrate *inference, evaluation and explanation* into your lessons.

Which planned experiences went well when promoting these skills? Think about the success or otherwise of your intentional teaching of these skills.

Discuss other experiences that took place which were not on your planned programme for the week.

Thinking about *inference, evaluation and explanation* what do you consider needs to be followed up on and why?

How would you go about extending these skills for your future lessons, providing possible changes and a rationale for them?

Week 3 Reflection: The promotion of:

Self-regulation – the drive to monitor and rectify your ways of thinking constantly, by

putting aside your own likes, beliefs and interests in order to achieve the most accurate understanding.

Open-mindedness - consideration of alternative possibilities and multiple points of views, including possible exceptions and the implications of conclusions made.

Problem-solving – the capacity to challenge unexpected problems, address the factors which contribute to the problem and find suitable resolutions.

Drawing from your experiences this week, please elaborate on how you plan to integrate *self-regulation, open-mindedness and problem solving*, into your lessons.

Which planned experiences went well when promoting these skills?

Think about how your intentional teaching of these skills.

Discuss other experiences that took place which were not on your planned programme for the week.

Thinking about *self-regulation, open-mindedness and problem-solving*
what do you consider needs to be followed up on and why?

How would you go about extending these skills for your future lessons, providing possible changes and a rationale for them?

APPENDIX E

Turnitin Originality Report

- Processed on: 17-Oct-2020 8:36 AM CAT
- ID: 1417901578
- Word Count: 48750
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DISSERTATION by Leeandri Kunniah-Ruttu

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< 1% match (Internet from 15-Sep-2020) https://tophat.com/blog/blooms-taxonomy/

APPENDIX F

ASOKA ENGLISH LANGUAGE EDITING

45 Vausedale Crescent, Escombe, 4093.

CELL NO.: 0836507817

THIS IS TO CERTIFY THAT THE FOLLOWING THESIS HAS BEEN ENGLISH LANGUAGE EDITED

PROMOTING CRITICAL THINKING SKILLS IN FOUNDATION PHASE MATHEMATICS

Candidate: Kunniah-Ruttu L.

.

[redacted]

DISCLAIMER

Whilst the English language editor has used electronic track changes to facilitate corrections and has inserted comments and queries in a right-hand column, the responsibility for effecting changes in the final, submitted document, remains the responsibility of the client and the editor cannot be held responsible for the quality of English Language expression used in corrections or additions effected subsequent to the transmission of this certificate on 13/10/2020.

Director: Prof. Dennis Schauffer, M.A.(Leeds), PhD, KwaZulu (Natal), TEFL(London), TITC Business English, Emeritus Professor UKZN. Univ. Cambridge Accreditation: IGCSE Drama. Hon. Research Fellow, DUT. Durban University of Technology.