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ANALYSIS OF THE INFLUENCE OF MINDSETS ON A STRONGLY FRAMED AND CLASSIFIED SUBJECT USING SOCIAL LEARNING THEORY

A thesis submitted to the Wits School of Education, Faculty of Humanities, University of the Witwatersrand in fulfillment of the requirements for the degree of Doctor of Philosophy.

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ABSTRACT

Mindsets are crucial in mathematics education and are linked to several processes and factors that are essential to learners in the learning process. However, mindsets are often overlooked in studies on mathematics learning and research with specific focus on mindsets in mathematics education is scarce. This study therefore explores and describes how mindsets may be linked to the learning of a strongly framed and strongly classified subjects (SFSCS), like mathematics, using social learning theory. Dweck's mindsets theories and Illeris's social learning theory were used as theoretical perspectives to understand learners' mindsets and their relations with mathematical learning. A qualitative research method was used with a purposive sample of one High School in Gauteng Province, South Africa. Ten learners, three mathematics teachers and the learners' parents participated in this study. Data sources involved interviews of learners and teachers and a completed questionnaire by the learners' parents. A discursive approach is used to analyse learners' views of their own experiences, in their own words, as well as the mathematics teachers' and parents' perceptions regarding the learners' experiences in the learning of mathematics. Findings of the study revealed that the high achieving learners are balanced and none of them see the cognitive dimension in fixed ways and the low achieving learners lack cognitive and emotional dimensions. More so, the teachers seem to show that the learners are cognitively able, but not always emotionally positive and social support is seen as vital in the learning of subjects like mathematics. The parents show that their children can achieve cognitively and emotionally in the learning process, with support. Notably, the three dimensions (cognitive, emotional and social) are central, as they connect each other, however, the learners' views, as well as the teachers' and ten parents' perceptions incline that the social dimension is crucial in the support of effective mathematics learning and, in turn, increases learners' achievement in mathematics. Mindsets are socially constructed and have an impact on the learning of subjects like mathematics. The findings suggest the need for interventions to support low achieving learners shifting from fixed to growth mindsets, in the cognitive and emotional dimensions of learning.

Keywords: Learning, SFSCS, mathematics, cognitive dimension, emotional dimension, social dimension, mindsets, growth mindset, fixed mindset, race, gender, beliefs, attitudes.

DECLARATION

I declare that this thesis is my own unaided work. It is being submitted for the degree of Doctor of Philosophy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



Abel Aghogho Uwerhiavwe

1st day of September in the year 2021

DEDICATION

To the Almighty God, who grants knowledge and wisdom to mankind.

PUBLICATIONS EMANATING FROM THIS RESEARCH

Journal Article

Uwerhiavwe, A. (submitted). On learners' mathematical social identities and their relation to mathematics learning. *The Mathematics Educator*. https://openjournals.libs.uga.edu/tme/authorDashboard/submission/2650.

Uwerhiavwe, A. & Abdulhamid, L. (in progress). Learners' mindsets and their influence on mathematical learning using social learning theory. *Journal of Education*.

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Tiffen and Rajasingham (1995) indicate “in a footnote in the pilgrim's progress, John Bunyan writes, the blessedness of savoury experimental conversation with fellow pilgrims cannot be too highly praised” (p. 97). In this light, an effort like this would naturally not yield any result without the support and encouragement of a number of people. In truth, when God is behind you, you cannot be behind. To these persons, I owe a word of gratitude for making this study a huge success as Evangelist General Tom of blessed memory affirms that a thankful heart is a grateful heart and a grateful heart is a Godly heart (Tom, 2019).

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CHAPTER 1

INTRODUCTION

The topic for this study is the **Analysis of the Influence of Mindsets on a Strongly Framed and Classified Subject Using Social Learning Theory**. Its aim, therefore, is to explore how mindsets may be linked to learning in the context of mathematics using social learning theory. It explores the development of and issues related to, mindsets in the learning process. The study also examines the implications of learners', teachers' and parents' mindsets on the learning of mathematics. This chapter highlights the background to the study, an overview of mindsets; learners' mindsets and social learning; the purpose of the study; the objectives of the study; and the research questions. Thereafter, I highlight the rationale and significance of the study. Finally, an overview of each of the chapters in this thesis is also provided, as well as the summary of the chapter.

1.1 Background to the Study

The educational system of South Africa has passed through many changes to rectify the biases and inequalities of the past. The educational changes have been historical and political to a large extent. The necessity to transform South Africa's system of education was vital. South Africa needed an educational system that shaped and enhanced democracy, human dignity, equality and social justice. The curricula used during the

apartheid era were authoritarian and heavy in content, as well as used rote learning and memorisation (Barnes, 2009; Weber, 2008; Department of Education, 2002; Jansen, 1999). Even with curricula changes in South Africa, learners' performances in mathematics have been consistently low in comparison to other school subjects. Learners' performances in mathematics in the rural provinces, such as Eastern Cape and KwaZulu-Natal, are lower compared to urban areas in the Western Cape and Gauteng (Department of Basic Education, 2014; Department of Education, 2002). The Department of Basic Education (2014) also indicates that High School mathematics does not adequately provide either equal education opportunities or the proper educational environment for learners. This influences the mindsets learners hold and their achievements in mathematics, as a subject that is strongly framed and strongly classified.

In line with the above and as affirmed by the Department of Basic Education (2014), as well as Department of Education (2002), Sibiya and Mudaly (2018) assert that several studies have been carried out on learners' poor performances in mathematics in South Africa, which occurs throughout the country. Sibiya and Mudaly (2018) further assert that the role of mathematics is "to equip learners with an ability to think critically, logically, systematically, innovatively and creatively. However, mathematics is still considered to be a difficult subject" (p. 90). Even considering the relative relevance of mathematics, it is very unfortunate to note that learners' performances in the subject have remained consistently poor. Learners who perceive mathematics as a difficult

subject often demonstrate a lack of interest in the subject and its learning. Mathematics educators have put a lot of effort into recognising the primary problems combating the learning of mathematics in schools. Despite these efforts, the problem of poor achievement in mathematics and its learning persists (Sibiya & Mudaly, 2018; Adolphus, 2011).

A number of factors have been posited as being responsible for the learners' low achievements in mathematics and its learning. These are (i) a poor background in mathematics, (ii) a perception that mathematics is difficult and that only some can do it, (iii) psychological fears or anxiety of mathematics and (iv) a lack of interest in the subject (Van Aalderen-Smeets & Walma Van Der Molen, 2018; Uwerhiavwe, 2014; Adolphus, 2011; Ajagun, 2006). Some researchers, such as Bishop (2012), Adolphus (2011) and Grootenboer and Zevenbergen (2008) argue that the lack of learners' interest and low retention rate in mathematics and its learning is also linked to teachers' mathematical content and pedagogical knowledge.

The persistent issues related to the learning of mathematics are associated with the learners' behaviour, for example: their interest, backgrounds, beliefs, determination, concentration, confidence, competence, willingness, anxiety and motivation. There are other issues related to mathematics classroom interactions, including negotiations, engagement and participation in learning mathematics (Sibiya & Mudaly, 2018; Ali, Bhagawati & Sarmah, 2014; Uwerhiavwe, 2014; Bishop, 2012; Adolphus, 2011; Grootenboer & Zevenbergen, 2008). To this end, locally, nationally and internationally,

there is substantial evidence of learners' declining participation in mathematics and its learning. In a lot of societies, learners are increasingly opting out of mathematics learning (Martin, Way, Bobis & Anderson, 2015; Murray, 2011; Leder & Taylor, 2010; Cann, 2009). Attard (2009) asserted that a lot of learners "fail to enjoy or see the personal relevance of mathematics and few voluntarily continue its study" (p. 41). In this light, Grootenboer and Zevenbergen (2008) argue that it was crucial to recognise that structural social issues, such as race and gender also prevented access to the achievement and enjoyment of mathematics in the learning process. In this sense, participation in classes at the higher levels continued to reduce as well and many learners held unhealthy and unhelpful views of learning mathematics (Grootenboer & Zevenbergen, 2008).

It is critical to note that there are questions about learners' participation, as well as achievements, in learning and why learners are opting out of learning, especially in subjects like mathematics. As such, some of the fundamental and frequent questions are (a) What are learners' beliefs about their intelligence and abilities towards mathematics learning? (b) Do learners believe they have the intelligence or ability to study mathematics? (c) Do learners believe they need a certain brain to study mathematics? (d) Do learners view themselves as smart enough to study mathematics? (e) Why do some learners drop mathematics whenever they can? (f) Why do some learners not give up, even when they are faced with difficulties in the learning process of mathematics (g) Why do some learners perceive mathematics and its learning as difficult and boring? (h)

Why do some learners perceive making mistakes as a lack of intelligence or abilities in mathematics learning? (i) Why do some learners perceive challenges as an inadequacy: the lack of intelligence or abilities in mathematics learning? (j) Why do some learners view failures as indictments of their intelligence or abilities and attempt to save face by resorting to self-handicapping strategies and defence against the threat of incompetency, by opting out of the learning process? (Moore, 2018; Martin, Way, Bobis & Anderson, 2015; Murray, 2011; Leder & Taylor, 2010; Attard, 2009; Cann, 2009; Thomas, Muchatuta & Wood, 2009; Watt, 2004; Jones, Howe & Rua, 2000). These questions, among others, offer the background to this study: which is the learners' mindsets about learning a strongly framed and classified subject, with a specific focus on mathematics in high schools in South Africa.

Learning mathematics is a multifaceted undertaking that entails the development of new ideas, at the same time, transforming the learner's current ways of doing, thinking and being. Learning mathematics includes the building up of every learner's mindset as a part of the mathematics community, being part of a which includes the learner's dealings and experiences with her/his peers, mathematics teachers, family and community. In this manner, learners begin to understand who they are in terms of learning the subject, mathematics. A common theme in the research is that, at every stage of mathematics learning, "something is going wrong for learners in mathematics classrooms and that this needs remedying; while teaching remains the focus of policy, it seems timely to consider the experiences of the learners and their learning of

mathematics" (Bernecker & Job, 2019; Haimovitz & Dweck, 2017; Mercer & Ryan, 2010; Bibby, Moore, Clark & Haddon, 2007, p. 16).

1.2 An overview of mindsets

A crucial factor that is frequently suggested to have an impact on the learners' attributes and dispositions (such as race, gender, attitudes, beliefs, perceptions) and motivation concerning their mathematics learning is the implicit theories (mindsets) of intelligence and abilities – the beliefs learners hold about their intelligence and abilities concerning mathematics and its learning (Boaler, 2016; Mercer & Ryan, 2009; Dweck, 2000). Hence, for several years, different researchers have presented the idea that [learners'] implicit theories (mindsets) of intelligence and abilities influence learners' achievement, as well as decisions in mathematics learning (Van Aalderen-Smeets & Walma Van Der Molen, 2018; Mercer & Ryan, 2009; Blackwell, Trzesniewski & Dweck, 2007). As such, Dweck classifies learners as having one of two kinds of mindsets: implicit theories, such as a fixed mindset; and entity theory or growth mindset – incremental theory (Boaler, 2016; Yeager & Dweck, 2012; Mercer & Ryan, 2009; Dweck, 2006; Dweck, 2000). The underlying core beliefs that account for this difference in learners' "personal qualities that shape the learners' response to challenge are the implicit theories (mindsets) of intelligence and abilities that learners hold regarding the malleability of their intelligence and abilities" (Van Aalderen-Smeets & Walma Van Der Molen, 2018, p. 4). Mindsets are beliefs that individuals hold concerning the nature

of intelligent behaviour. Thus, learners' mindsets are their beliefs that are "not explicitly articulated in a learner's mind, but that form a schematic knowledge structure that guides the learner's perceived beliefs about his/her abilities, independent from their actual intellectual ability" (Van Aalderen-Smeets & Walma Van Der Molen, 2018, p. 4; Dweck, 2013c; Dweck, 2013b; Mercer & Ryan, 2009; Dweck, 2000).

More so, Dweck posits that when people attribute intelligence to fixed traits (i.e., they hold a fixed notion of intelligence), they have a fixed mindset. They believe that their qualities, such as intelligence and talents, are "set in stone" and cannot be changed through learning. This is a learner's belief in the innateness of ability: a learner either has it or he/she does not (Dweck, 2000, p. 2). People with fixed mindsets are scared of failure, because this suggests that they are not intelligent. The opposite of a fixed mindset is a growth mindset. People with growth mindsets believe that "intelligence is not a fixed trait they simply possess, but something that they can cultivate through learning" (Dweck, 2000, p. 3) and that effort and training can change a person's intelligence, through learning and practice. They hold a growth notion of intelligence and attribute success to learning. Such people are not scared of failure, because it suggests that there is a need to apply effort and time to practice and be conversant with new learning opportunities. Learners' mindsets are the beliefs learners have of themselves as learners. These influences their achievement in mathematics and its learning (Dweck, 2013c; Vermeer, 2012a; Vermeer, 2012b; Mercer & Ryan, 2009; Dweck, 2000).

Any of the mindsets which a learner develops in a learning process has implications for the ways in which she/he engages with opportunities in her/his entire life. A more critical look at learners' beliefs, attitudes and ability in mathematics and its learning reveal their intersection with learners' mindsets. This has an impact and influence on the learners' achievements in the subject (mathematics) and its learning (Martin, Bostwick, Collie & Tarbetsky, 2017; Heyd-Metzuyanim, 2013; Bishop, 2012; Bibby, Moore, Clark & Haddon, 2007). Grootenboer and Zevenbergen (2008) argue that there has been little progress in the direction of improving and tackling issues, such as learners' psychological fear or anxiety of mathematics; and their lack of interest, confidence, competence, perseverance and concentration. These are some of the factors which prevent learners of mathematics from achieving and enjoying the subject and its learning. The exploration of learners' mindsets and the implications for their achievements in learning in the context of mathematics is the focus of this study, to develop and improve the learning of mathematics in high schools. There are various attributes of learners' mindsets and their implications for their achievement in learning.

It is noteworthy to affirm that diverse learning conditions, contexts and subjects offer diverse learners' mindsets responses. The apprehension concerning the perpetual decline of learners' participation in mathematics and their learning also gave rise to the study to focus primarily on learners' mindsets and learning in the context of mathematics. The subject (mathematics) may perhaps communicate the strongest, fixed ability messages and thinking (Boaler, 2013; Mercer & Ryan, 2010; Dweck, 2008;

Dweck, Chui & Hong, 1995). This is taken up further in the literature review and theoretical framework, which is how researchers and scholars theorise plus explore learners' mindsets concerning mathematics learning, respectively.

There are various attributes of learners' mindsets that have an impact on their achievements in the learning of mathematics. Many learners fear and hate mathematics because they perceive it as being complex, abstract and only for the proficient. Boaler (2014) highlights that most learners believe that learners who attend mathematics are either high achievers or not; and that they need a certain "mathematical" brain to be high achievers in mathematics and its learning. Boaler (2014) further highlights a situation where learners tell their peers that they cannot learn mathematics and that mathematics is hard. It is the worst of all subjects. These learners feel comfortable not doing well, as they feel that mathematics is impossibly difficult. These negative feelings evince a lack of interest plus a low retention rate. All these factors lead to underachievement in mathematics and its learning (Ali, Bhagawati & Sarmah, 2014; Bishop, 2012; Kurumeh, Onah & Mohammed, 2012; Ajagun, 2006).

A focus on learners' mindsets provides a means of understanding, unpacking and addressing the learners' emotional responses and their self-positioning with respect to other learners and the surrounding discourses of mathematics education. The ways learners perceive themselves as a learner is crucial for their achievement plus success in the learning process (Moore, 2018; Blackwell, Boaler, 2016; Trzesniewski & Dweck, 2007). It is imperative for the learners to understand their beliefs and if these beliefs

positively or negatively influence their learning. Hence, Dweck and some researchers posited that learners' mindsets about intelligence and abilities play central roles in their achievement in learning. Furthermore, learners' mindsets can help to theorise about learning generally. Besides, learners' mindsets equally help us to have an in-depth understanding of the experiences of learners in the learning process (Moore, 2018; Tirri & Kujala, 2016; Blackwell, Trzesniewski & Dweck, 2007). This implies that learners' mindsets have become an investigative lens for developing in-depth understandings of mathematics learning (Moore, 2018; Dinger & Dickhauser, 2013; Chen & Pajares, 2010; Anthony & Walshaw, 2009; Grootenboer & Zevenbergen, 2008; Blackwell, Trzesniewski & Dweck, 2007).

It is worthy of note that the vast quantity of research on learners' mindset seeks to show the influences of learners' mindsets on learning subjects like mathematics. Learners' mindsets are important for an in-depth understanding of differences in learners' performance in the classrooms, as well as for forecasting long-term differences in learners' achievement in learning. More so, different learners' mindsets about intelligence and abilities across academic domains have consequences for their achievement in these domains (Moore, 2018; Zhang, Kuusisto & Tirri, 2017; Burnette, VanEpps, O'Boyle, Pollack & Finkel, 2013; Shively & Ryan, 2013; Bishop, 2012; Anthony & Walshaw, 2009; Mercer & Ryan, 2009). These implications are explored in Chapter Two.

1.3 Learners' mindsets and social learning

According to Bishop (2012) and Heyd-Metzuyanim (2013), it is imperative to note that many learners who are even successful in mathematics drop the subject immediately when they can. More so, they decide to continue or discontinue with the study of mathematics whenever they have the opportunity to do so (Darragh, 2016). This might be as a result of the learners' mindsets they hold toward mathematics and its learning. This standpoint was underscored by Dweck, who focused on individuals' self-theories. The literature review and theoretical framework discuss in detail the mindsets people hold and their relation to learning in the context of mathematics. It is important, at this point, to indicate that this study draws on Dweck's mindsets theories and uses Knud Illeris's social learning theory to complement mindsets theories. This is done in order to understand learners' mindsets and their relations with learning a strongly framed and strongly classified subject, like mathematics. This means that, for this study, learners' mindsets are viewed as being socially constructed and accessing how learners experience these social constructions of their mindsets, their voices and the ways in which they express their own experiences are seen herein as important. A discursive approach is used in this study to analyse learners' views of their own experiences in their own words. Similarly, teachers and learners' parents expressed views are also analysed in this study, using a discursive approach, which uses narratives centrally to capture the voices and experiences of learners, their teachers and parents. However, these narratives are also viewed as being socially constructed in this study.

As mentioned above, Dweck's mindsets theories (beliefs about people's qualities, as well as what and the ways they learn) are premised on two unique kinds of mindsets: growth mindset and fixed mindset (Dweck, 2013b; Dweck, 2012; Dweck, 2000). Illeris's social learning theory is premised uniquely on the three learning processes and which are basically classified into the external and internal learning processes, such that it encompasses the learning field entirely. The learning processes are (i) external learning process–the external interaction process between learners and their social plus cultural or material environment, which is the social process (dimension); and (ii) internal learning process – the internal psychological processes of acquisition and elaboration, which are the cognitive and the emotional processes (dimensions). Illeris highlights that learning takes place on different levels (cognitive level, emotional level and social level) and the levels are influenced by social context and support of the kind of practice that impacts on it in the environment (Illeris, 2009; Illeris, 2007; Illeris, 2003). These mindsets and social learning theories will be explicitly discussed in the subsequent two chapters. The theoretical stance that underpins and informs this present study, such as Illeris social learning theory and Dweck's mindsets theories, serves as the theoretical lens to explore the influence of mindsets in the learning of strongly framed and classified subjects like mathematics.

1.4 Statement of the problem

Learners' mindsets are of grave concern and becoming widespread in scholarly and public discourse. Researchers are paying increasing attention to learners' mindsets as a key element in learning, because they help researchers to understand the attributes of improving the learners' skills, as well as learning of mathematics and development. It is not surprising that learners' mindsets have gained traction in educational contexts as they are critical in education. There is increasing evidence that gives support to the existence of learners' fixed mindset and growth mindset about intelligence and abilities, as well as about the consequences of learners' fixed mindset and growth mindset for their incentive and achievement in the learning process.

Recently, some researchers (Boaler, 2016) have focused on the concept of learners' mindsets and how and why it influences the learning of mathematics. Learners' fixed and growth mindsets are relatively conceptual terms that are frequently used in the learning and teaching of mathematics; although they has been more broadly used in other educational plus developmental psychology, as well as social and medical research. A learner's mindset is a powerful and substantial factor, as well as an integral part of mathematics proficiency. Researchers across a variety of fields suggest that learners' mindsets are a crucial subject of concern in teaching and learning (Moore, 2018; Van Aalderen-Smeets & Walma Van Der Molen, 2018; Badyal & Singh, 2017; Luftenegger & Chen, 2017; Bishop, 2012; Anthony & Walshaw, 2009; Dweck, 2006).

A lot of Dweck's works have focused on learners' mindsets about intelligence and abilities. Dweck asserted that beliefs about the stability or malleability of a learner's intelligence are vital to a learner's understanding and critical to our understanding of the world (Moore, 2018; Tirri & Kujala, 2016). To this end, mindsets are critical in mathematics education – people's implicit beliefs about the nature of learners' intelligence and abilities are an essential factor in forecasting their performances in all school subjects. Therefore, the importance of mindsets and how they influence their learning cannot be overemphasised. A mindset is linked to various processes and factors that are essential to the learners in the learning process, such as their self-efficacy, academic resilience, academic adaptability, task difficulty, task choice, task engagement, task enjoyment, goal, persistence and attributions. However, mindsets are often overlooked in studies on the learning of mathematics, despite these reasons. Research on the specific focus on mindsets in mathematics education is scarce (Moore, 2018; Martin et al., 2017; Tirri & Kujala, 2016). The lack of research on the specific focus on mindsets in mathematics education inspired me to conduct this study. This study, therefore, aims to explore attributes of mindsets that most influence learning of a strongly framed and strongly classified subject like mathematics, using Illeris's social learning theory.

1.5 The purpose of the study

The purpose of this study is to explore and describe mindsets, as well as their implications for the learners' achievements in learning of a strongly framed and strongly

classified subject, in the context of mathematics and in relation to social learning theory. Through the narratives of the participants by interviewing the learners and their mathematics teachers, as well as administering questionnaires to the learners' parents, I explore the features of mindsets which are crucial and have implications for the learners' learning of a strongly framed and strongly classified subject, like mathematics.

1.6 Objectives of the study

a) To determine the influence of learners' mindsets on mathematics learning within the cognitive dimension.
b) To determine the influence of learners' mindsets on mathematics learning within the emotional dimension.
c) To determine the influence of learners' mindsets on mathematics learning within the social dimension.
d) To explore the pattern of mindsets (if any) across the three dimensions of learning within low and high achieving learners.

1.7 Research questions

The main research question that guided the study is: What is the influence of mindsets on learning of a strongly framed and strongly classified subjects, like mathematics?

In answering this research question, the following sub-research questions, driven by crucial issues identified in the learning of a strongly framed and strongly classified

subject (SFSCS) in high schools in South Africa, that I have delineated in this chapter and which is linked to international literature, were interrogated:

i) What is the influence of learners' mindsets on mathematics learning within the cognitive dimension?
ii) What is the influence of learners' mindsets on mathematics learning within the emotional dimension?
iii) What is the influence of learners' mindsets on mathematics learning within the social dimension?
iv) What pattern of mindsets (if any) across the three dimensions of learning are seen within the low and high achieving learners?

1.8 Rationale and significance of the study

I was inspired to conduct this study because of my masters' degree research study. I explored and identified the impact of mathematics teachers' development and mathematics learners' preparation in mathematics education in senior secondary schools in Delta State, Nigeria. This study laid the foundation for improving the teaching and learning of mathematics. I understood and identified the problems and challenges facing mathematics education and suggested some possible remedies to improve the learners' performances in mathematics and its learning (Uwerhiavwe, 2014). I only looked at the attributes responsible for learners' achievements in the subject, mathematics, without giving proper attention to the learners' mindsets, as Dweck explores them. I did not study the learners' mindsets which they constructed as a result of the learners' and others' beliefs and attributes towards mathematics learning. I also did not study how the

learners' mindsets were constructed in the process of learning the subject, as well as using Illeris's social learning theory.

The advantage of the study of mindsets in relation to learning [with the aid of Illeris's social learning theory] is not only to allow researchers to focus on learners' capability as the attributes that influence their learning and achievement in mathematics. It is crucial, in this study, to understand the other attributes which influence the learners' mindsets that are developed in the study of mathematics. It is also important to identify the problems and challenges facing mathematics education that have an impact on learners' achievements, as well as suggesting appropriate remedies.

It is hoped that this study contributes to other research on issues related to mindsets. It will add value to research on mindsets and encourage other researchers in mathematics education to study mindsets. This will expand their understanding of mindsets, plus the attributes which constitute learners' mindsets and the subsequent impact mindsets have on learning and achievements in mathematics.

1.9 An overview of the thesis

In **Chapter 1**, this study is introduced. The background and foundation for the study that was conducted are outlined. The purpose and objectives of the study are briefly discussed. The purpose of this study is to explore and describe mindsets and their implications on the learners' achievements in learning in the context of mathematics and

in relation to SLT. Through the narratives of the participants, I explore the attributes of mindsets that are crucial and have implications for the learners' achievements in the learning of mathematics. These are framed by the main research question: What is the influence of mindsets on learning of a strongly framed and strongly classified subject? The rationale and significance of this study are also discussed. The rationale for this study is the dearth of research on learners' mindsets and their influences on learning of subjects like mathematics, as well the inspirations I derived from my immediate previous study.

In **Chapter 2**, I review literature related to the concept of learning from a broader sense; and some key issues relating to learning are reviewed. As such, I conceptualise the definition of learning resulting from the reviewed literature and I take a stand from the reviewed literature on what the concept of learning is in this study. I discuss learners' attributes and dispositions, as well as how they (attributes and dispositions) influence their (learners) learning. More so, I review literature primarily in relation to strongly framed and strongly classified subjects (SFSCS), where I note, from the reviewed literature, that the concept of mathematics is referring to SFSCS. The concept of mindsets is reviewed as well. To this end, I conceptualise mindsets based on beliefs about the SFSCS and its learning; thereafter, I note that mindsets are socially influenced and constructed. Learners' emotions and cognition likewise influence their mindsets. The literature reviewed illuminates the two distinct types of mindsets (fixed and growth) people hold and their relationships to learning. The reviewed literature further

illuminates the common and pervasive importance of mindsets, comparing the two types of mindsets and deliberates on interventions for shifting learners' mindsets. Most of the studies reviewed are qualitative. While reviewing all these studies, I recognised that the qualitative methods used gave the researchers ample opportunities to obtain detailed information from the participants, which offered an in-depth understanding and dense description of their personal experiences. With this in mind, I decided to conduct this study qualitatively since it is appropriate for obtaining the necessary data.

Chapter 3 discusses the theoretical stance that underpins and informs this study. Specifically, I use the three dimensions (cognitive, emotional and social) of Illeris's social learning theory (ISLT) to frame the study. Within this frame, I also look at Bernstein's notion of a strongly framed and strongly classified subject (SFSCS) and Dweck's mindsets theories (MSTs)—that is, Dweck's distinction of the fixed mindset and growth mindset. Together these enable me to understand the influence of mindset within the cognitive, emotional and social dimensions of a learner in the learning of a strongly framed and strongly classified subject (SFSCS). I provide a justification for the suitability of Illeris's social learning theory (ISLT) for this study. This is followed by a detailed discussion of Illeris's three dimensions of learning and how they are framed in this study. Finally, based on Illeris's three dimensions of social learning and Dweck's mindsets theories, I conceptualise a model that shows the key concepts of this study.

Chapter 4 involves a discussion of the methodology. A qualitative research method was used as the underlying research design. A case study design was used as the

approach to the qualitative research method. A high school in the Gauteng Province of South Africa was the site of the study with the Grade 9 learners, their mathematics teachers and parents as sampled respondents. I made the choice of this site for exploration based on its convenience and the fact that the site was a mixed school based on gender and race. Prior to the main study, a pilot study was carried out with a learner, the mathematics teacher and the learner's parent, who were purposefully selected. The sample size of this study (main study) was twenty-three. A purposeful sample of the combinations of ten learners was selected on the basis of race, gender and achievement. The mathematics teachers who taught the learners and the learners' parents were selected as well. Triangulation was used to support the analysis of the findings. To achieve triangulation, the research instruments interviews and questionnaires were used and the interviews audio recorded. The credibility, dependability and confirmability of the study are discussed to account for the quality and rigour. I searched for dis-confirming evidence as well. Ethical issues were given consideration. I acted ethically and did not infringe on any of the participants' human rights. I used an inductive approach to analyse the data collected. I had to work with a small number of learners in a high school to carry out my study.

In **Chapter 5**, I develop the analytical framework of this present study. As such, I put together the theoretical field (theories that underpin the study) and the empirical field (collected data) of this study to develop the analytical framework. The Illeris's three dimensions of learning (cognitive, emotional and social) and Dweck's two types of

mindsets (growth and fixed) provided the backbone for the development of this analytical framework. It was noted that there was no analytical framework that brings together the mindsets theory and social learning theory. In this regard, the analytical framework developed in this study presents one of the major contributions to this field. The three dimensions of learning are not mutually exclusive in the empirical space. They were differentiated in this chapter only for analytical purposes. It is worthy to note that, through extensive working with the empirical data in this study, as well as the theoretical field, each dimension of Illeris's social learning theory was subdivided into two broad categories: a growth mindset and a fixed mindset. Codes were used for each of the categories and code identification/recognition rules were provided for each code. While the dimensions and mindsets were drawn from Illeris's and Dweck's theories, much of the codes and the code identification indicators were developed from working with the data obtained from the learners and their mathematics teachers' interviews, as well as their parents' questionnaires.

In **Chapter 6**, I present findings from the interviews of ten learners by delineating the influence of learners' mindsets on their mathematical learning. I present the case studies in two broad categories: low achieving learners and high achieving learners. In each category, individuals case studies were profiled and a summary of pattern across the low and high achieving learners was discussed. I found that learners' mindsets, beliefs, attitudes and perceptions are not something innate, but could be socially constructed. More so, I found that learners' mindsets have various consequences for their learning.

Bringing the learners as a cluster meant that the cognitive growth mindset and the cognitive fixed mindset could be similar and the emotional fixed mindset could be more, but the learner(s) with such qualities could still perform well in a SFSCS, like mathematics. Also, the social dimension is very essential in learning mathematics.

In **Chapter 7**, I present findings from the interviews with teacher and parent responses to a questionnaire relating to how they perceived learners' mindsets. The teachers seem to show that the learners are cognitively able, but not always emotionally positive and social support is seen as vital in the learning of subjects like mathematics. The parents reveal that their children could achieve cognitively and emotionally with support in the learning process

In **Chapter 8**, I begin with restatement of the main focus of the research with emphasis on the analysis process. Subsequently, I move on to provide a summary of the key findings emanating from this study. I then juxtapose the findings that emanated from the analysis of the responses from the interviews and questionnaires, as well as provide the implications of the findings. Thereafter, the contribution of the study to existing knowledge and its limitations are summarised and certain recommendations for further studies are provided.

In the next chapter, I have set up a literature review for the study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This study explores the influence of learners' mindsets on learning of strongly framed and classified subjects. In this chapter, I review studies on the concept of learning, strongly framed and strongly classified subjects (using mathematics as an example) and mindsets. I then explore literature regarding learners' attributes that co-construct their (learners) mindsets in the context of learning of a strongly framed and strongly classified subject (SFSCS). Although, I am working with Dweck's mindsets theory, I am linking it with Illeris's social learning theory. Finally, I discuss literature on learners' dispositions and their influence on learning. The review group researchers who draw similar conclusions compare different researchers' views, identify areas that need further research, establish the gaps in research this study intends to fill and show how this study relates to previous studies.

2.2 The concept of learning

There is an agreement that learning is crucial. However, people have different standpoints on what makes learning occur, as well as the consequences of learning. As such, there are numerous conceptualised definitions of learning, but there is not one definition of the concept of learning that is generally accepted by theorists, researchers,

scholars and practitioners. There is a disagreement about the exact nature of learning. Schunk (2012), Illeris (2009), Illeris (2003) and Illeris (2003) assert that learning covers all the processes that lead to relatively lasting changes of capacity, whether they be of a motor, cognitive, psychodynamic (i.e., emotional, motivational, or attitudinal) or social character and which are not due to genetic-biological maturation or ageing. However, Illeris (2003) views learning in its broad sense as "a very complex process which encompasses both biologically founded psychological and societally founded social elements which follow different sets of logic and work together in a complex interaction" (p. 398). In other words, Illeris affirms that learning can generally be defined as "any process that in living organisms leads to permanent capacity change and which is not entirely a function of biological maturation or ageing" (Strauch & Alomar, 2014, p. 63; Illeris, 2007, p. 3). Illeris's definition of learning offers an understanding of the concept of learning from "biological, psychological and sociological perspectives, including learning and the brain, embodied and unconscious learning" (Illeris 2007, p. 22). Therefore, learning involves "psychological development, socialisation and qualification" (Illeris 2002, p. 24).

Acquisition is a keyword that is often used in most definitions of the concept of learning, specifically in traditional definitions (Strauch & Alomar, 2014; Illeris, 2009). At the same time, "there has been rapid development of ideas about the sort of learning that is necessary and desirable" (Illeris, 2003, p. 397). Notably, learning is not only all about the acquisition of knowledge, skills, beliefs, attitudes, values and behaviours as a

lot of what people perceive (Strauch & Alomar, 2014; Illeris, 2009). In Illeris's (2003), but "learning can no longer be conceived of as merely the acquisition of a syllabus or curriculum". It is crucial to say that learning is a multidisciplinary matter and it is difficult to get hold of an all-inclusive understanding of it. Learning is a very complex process whereby one translates information and experience into knowledge, skills, strategies, beliefs, attitudes and behaviours. Everyone has the ability to learn, to varying degrees (Strauch & Alomar, 2014; Schunk, 2012; Illeris, 2007; Illeris, 2003, p. 397). Strauch and Alomar (2014) assert that learning is a process that brings "together with the influences and the experiences of cognition, emotion and the environment to acquire, enhance, make changes in one's knowledge, values, skills and world views; and, as a process, learning focuses on what occurs during the act of learning" (p. 63).

Jarvis (2006) conceptualises learning as the combination of processes by which a learner's entire body (genetic, physical and biological), as well as his/her mind (knowledge, skills, attitudes, values, emotions, beliefs and senses) "experiences a social situation, the perceived content of which is then transformed cognitively, emotively or practically (or through any combination) and integrated into the person's biography resulting in a changed (or more experienced) person" (p. 13). The general definition of learning that is consistent, as well as entails the criteria most educational professionals accept as fundamental to learning, is that "learning is an enduring change in behaviour, or in the capacity to behave in a given fashion, which results from practice or other forms of experience" (Ertmer & Newby, 2013; Schunk, 2012).

Schunk (2012) argues that the general definition of learning is consistent and involves most criteria that can be examined in detail to recognise three criteria that learning holds: (a) Learning involves change: learning involves a change in behaviour or the capacity for behaviour. This suggests that a person learns when he/she can do something different. Simultaneously, there is a need to remember that learning is inferential. It is not observed directly, but seen relatively in relation to its outcomes. More so, learning encompasses a “change in capacity to behave in a given fashion as it is common for people to learn skills, knowledge, beliefs, or behaviours without demonstrating them at the time learning takes place” (p. 4). (b) Learning endures over time: this criterion does not involve impermanent behaviour that is induced by factors, such as drugs, alcohol and fatigue. These changes are impermanent, because when the thing that induces it is removed, the behaviour goes back to its original state. However, learning might not last forever as forgetting takes place. Furthermore, “it is arguable how long changes must last to be termed as learned, however, most people agree that changes of brief duration (for example, a few seconds) do not qualify as the occurrence of learning” (p. 4). (c) Learning occurs through experience: examples of this criterion are practice and observation of others. This does not include behavioural changes that are determined by heredity, such as maturational changes in the learner (for example, crawling and standing). People may be genetically predisposed to act in given ways, but the actual development of the behaviours depends on the environment. Language is one example: because of the maturity of the human vocal system, human beings become capable to produce language. However, "the actual words produced are learned from

interactions with other people. Though genetics is critical for learners' language acquisition, teaching and social interaction with parents, teachers and peers exert a strong influence on learners' language achievements" (p. 4). In this study, I have fundamentally considered more of criterion one (learning involves change), which proposes capacity change with learning content as an element of learning; and criterion three (learning occurs through experience), which proposes society and social environment with learning context as an element of learning (Jarvis, 2006), since criteria one and three are crucial and more suitably fit this present study. However, I am not considering criterion two, because it proposes that it is induced by factors like drugs, alcohol and fatigue (Jarvis, 2006) This is not relevant for this present study.

To elucidate and describe what occurs in the process of learning, it is worthwhile to further explain theories of learning: these are an organised set of principles that explain and describe how learners acquire, process and hold knowledge in the process of learning. To this end, learning theories are used to explain the ways in which people learn and make one have an in-depth understanding of the complex processes that are involved in learning (Strauch & Alomar, 2014; Illeris, 2009; Illeris, 2007; Illeris, 2003; Illeris, 2002). This will be explicitly discussed in the next chapter.

2.3 Socialisation into the knowledge of a strongly framed and strongly classified subject.

Bernstein (1971) posits that boundaries are about classification. If the classification is strong, then the boundaries are strong; if the classification is weak, then the boundaries are weak. As such, within boundaries, maintenance is strong when something is strongly framed. The boundaries around the knowledge are not porous, but strong. One cannot break outside of this. If one needs to understand the subject, say mathematics, one needs to understand it within the boundaries. An example would be 1 + 1 = 2. One cannot learn this in another way, but only in that way (symbolic way). It is something that is strongly framed (F^+), because it is learned by rote (i.e. memorising it). Conventionally, framing has to do with the relationship between the teachers and the learners and the control they have over the content of the subject being taught. Framing is also a message system of pedagogy (Sun, 2018; Bernstein 1975 & 1971).

Framing, therefore, refers to relations within boundaries. Strong framing entails reduced options. As such, framing is referred to as the location of control over the communication rules (Bernstein, 1975; Bernstein, 1971). That is ‘frame’ correlates with ‘control’: "frame refers to the degree of control teacher and learner possess over the selection, organization, pacing and timing of the knowledge transmitted and received in the pedagogical relationship". (Bernstein, 1975, p. 88; Bernstein, 1973, p. 88; Bernstein, 1971, p. 50). In this regard, strong framing is referred to as a limited degree of options

between teachers and learners – specifically, strong framing implies that learners have limited control over the relations within, plus a limited degree of control over the sequencing, pacing, selection and evaluation of the transmitted knowledge. However, weak framing implies more control by the learners. This would take place when the teachers are able to make choices of topics based on the learners' interest or some other principle, as well as organise the sequence and pacing of material corresponding to the learners' readiness and phase of development.; i.e., weak framing implies more freedom (Bernstein, 1973). According to Bernstein (1971), strong framing knowledge [that is why it has its language] is formulaic and abstract. A curriculum with rigid topics that are to be completed in a predetermined order, within a specified time [say mathematics curriculum], represents strong framing. This is termed a collection code, which socialises a learner into viewing knowledge (school knowledge) as something that is distinct from his/her everyday knowledge.

A collection code is a knowledge that is strongly framed (F^+). The boundaries around it are strong and are strongly classified (C^+). Classification is the degree of maintenance between categories and includes the boundaries. Put simply, classification is referred to as the "degree of boundary maintenance between contents" (Bernstein, 1973, p. 205) (i.e. classification is boundaries) and it is concerned with the boundaries or insulation between curricular categories (areas of knowledge plus subjects). Strong classification means strong boundaries, where boundaries are explicit and categories are separated from each other, such as when the school timetable comprises of separate subjects, for

instance: history, geography, English language, mathematics and so on. Strong classification is one of the characteristics of the collection code. There is no control that either the teachers or learners have over the content of a strongly framed and strongly classified subject. One can only teach or learn it in a specific way. Learners and teachers have reduced choice. They just must memorise it. More so, strong educational personalities are established early in learners' educational careers. Strong classification poses a strong grading system: to a large extent, an individual knows exactly how well he/she is doing in the system and where he/she is in the academic hierarchy of the subject. These influence mindsets concerning the subject and its learning. Strong classification is also referred to as a curriculum that is highly differentiated and separated into traditional subjects (Bernstein, 1973; Bernstein, 1971). However, weak classification is referred to as a curriculum that is integrated, whereby the boundaries between subjects are fragile. It is crucial to note that classification does not just mean what is classified, but the strength of the boundaries of what is classified: relationships between contents. (Bernstein, 1973; Bernstein, 1971).

Ensuing from the above, mathematics is a strongly framed and strongly classified subject (SFSCS), as its learning and knowledge are strongly framed (F^+), strongly classified (C^+), abstract and formulaic. Furthermore, the teachers' and learners' participation in relation to SFSCS is restricted. As such, teachers and learners of SFSCS do not have much power and control or say over a SFSCS, as well as its knowledge and what is required. These influence people's mindsets concerning the subject and its

learning. It is critical to note that a learner gets socialised into strongly framed and strongly classified knowledge of a subject [like mathematics].

Bernstein (1971) also posits that "how a society selects, classifies, distributes, transmits and evaluates the educational knowledge it considers to be public, reflects both the distribution of power and the principles of social control" (p. 47). All knowledge is about power. Invariably, mathematics knowledge is about power. Mathematics content knowledge is thus strongly framed. The reason one learns mathematics is not only that it is interesting and fun, it is lucrative as well. Mathematical skill is much sought after. Mathematics is not only about mathematics. It is valued because it is vital for the economy of a society. How do you count money? You count money using mathematics. Why do you feel mathematics has status? Mathematics helps people to count money. Mathematics is about power, as well as political and socio-cultural status. Thus, mathematics education plays a vital role in the economic growth and ability to negotiate the trend towards globalisation of all aspects of national culture and quality of life. More so, to be fully involved in any democratic processes and to not be restricted in any career choice and advancement in a society, people must be able to understand and apply mathematics concepts. (Obomanu & Adaramola, 2011; Reyes & Stanic,1998).

Mathematics occupies the largest part of the school curriculum (Bansilal, Webb and James, 2015). About 60% of the timetable in schools is given to mathematics as a subject. There is an imbalance. Other subjects, such as history and geography have less timetable space, when compared to mathematics, as they might be regarded as less

important. Some subjects (mathematics in particular) have high-status, while some have a lower status. "Any curriculum entails a principle or principles whereby of all the possible contents of time, some contents are accorded differential status and enter into opened or closed relation to each other" (Bernstein, 1971, p. 49). It appears that most teachers use other subjects' time for mathematics to improve learners' mathematical skills. Mathematics is prioritised. Bansilal, Webb and James (2015) assert that:

> as a progressive economy in this century, South Africa was faced with large numbers of the population showing low levels of competence in mathematics. As a lack of numerical competencies had a negative effect on employment and economic development, it was incumbent on learners in Grades 10, 11 and 12 to choose between mathematics or mathematics literacy as part of their National Senior Certificate curriculum. According to the Department of Education, mathematics literacy contributes to economic success. Learners will become citizens who can negotiate and function in the economic world with everyday mathematical calculations and problems. Learners are expected to use these skills to help advance South Africa in a rapidly advancing scientific and technological world once they leave school (p. 1).

The South African government implemented a policy that mathematics was compulsory. Every high school learner from Grade 10 to 12 had to learn mathematics. This was to ensure economic growth. Mathematical skills depend on the way we frame mathematics, construct it and give it status (the way we put things in place). This shows the way in which knowledge has developed. Knowledge is not static, but dynamic and develops all the time. We give mathematics more importance and status. There is no doubt, for very good reason(s), that mathematics is very important, but there is nothing about the knowledge of mathematics that makes it more important than all the other subjects. Society has given mathematics a high-status position. Every subject has its role(s) in society (Bansilal, Webb & James, 2015).

I now look at learners' mindsets in a strongly framed and strongly classified subject and the way the mindsets are perceived and experienced within a social learning context to complement and help to explain them, likewise in the analysis of this study. This will be discussed in the next chapter. It is crucial to note at this juncture that, henceforth, I am viewing mathematics as a strongly framed and strongly classified subject. As such, whenever I mention a strongly framed and strongly classified subject in this present study, I am referring to mathematics.

2.4 The concept of mindsets

Over two decades, Carol Dweck and her research teams assert that all learners react in very different ways to challenges and setbacks: while some learners are easily disturbed by difficulties and try all means to avoid their challenges and setbacks, other learners like the challenges and setbacks and they are even actively looking for them (Tirri & Kujala, 2016; Dweck, 2006a). To this end, all learners have developed a mindset. Mindsets are the fundamental assumptions people develop about human qualities like intelligence and abilities: a fundamental belief about how people learn and what they do. Hence, learners react to challenges and setbacks differently in the learning process. In other words, a mindset is a belief about people's qualities plus what they learn and the way they learn (Boaler, 2016; Tirri & Kujala, 2016; Yeager & Dweck, 2012). Learners' mindsets are critically essential as research has shown that they lead to different learners' behaviour. This, in turn, establishes different learning outcomes of the learners (Tirri & Kujala, 2016). The two mindsets that can develop in learners are (a)

The negative mindset, which leads to failure. This is the fixed mindset. (b) The positive mindset, which leads to success. This is the growth mindset (Bernecker & Job, 2019; Boaler, 2016; Tirri & Kujala, 2016; Yeager & Dweck, 2012).

Mindsets embody certain rudimentary assumptions of learners about their numerous qualities, such as personality, intelligence, smartness and various forms of ability (Dweck, 2013b, 2006a & 2006b; Mercer & Ryan, 2010). These qualities are perceived as being fixed or static, by some individuals. For instance, some teachers and learners perceive intelligence and abilities as being fixed; that some learners are born gifted, talented, intelligent, or smart and can effectively learn SFSCS; and nothing anyone can do about it can change these central personalities. This perception (belief) is regarded as a fixed mindset [or entity theory]. In other words, people have the belief that a learner is who he/she is, that his/her intelligence and talents are fixed; and his/her destiny is to avoid challenges and failure in life. People who hold a fixed mindset emphasise "performance goals ('looking smart' and 'proving their abilities')". As previously mentioned, this mindset is one that is negative and leads to poor performance (Bernecker & Job, 2019; Rissanen, Kuusisto, Tuominen & Tirri, 2019, p. 204; Boaler, 2016; Dweck, 2013a; Dweck, 2013b; Yeager & Dweck, 2012).

On the other hand, some teachers and learners perceive the qualities as malleable and are thus amenable to change plus development. Learners do have the capability to change. In other words, they believe that intelligence and smartness can be learned. As such, learners do have the ability to change these central personalities – they believe

that they have the capacity to learn and grow. This belief is referred to as a growth mindset [or incremental theory]. This mindset is one that is positive and leads to better performances. For instance, with mentoring, a learner of a SFSCS could become more adept. People who hold a growth mindset emphasise “learning goals (‘becoming smart’ and ‘improving abilities’), appreciation of effort and understanding failures as learning opportunities”. Learners and teachers of SFSCS tend to have fixed or growth mindsets (Rissanen, Kuusisto, Tuominen & Tirri, 2019, p. 204; Zion & Crum, 2018; Haimovitz & Dweck, 2017; Mutodi & Ngirande, 2014; Boaler, 2013; Dweck, 2006a; Dweck, 2006b; Carey, 2012). To this end, I have chosen to use the more readily understood term, mindsets - fixed mindset and growth mindset instead of implicit theories, entity theory and incremental theory as the term mindsets is “more encompassing and better conveys the comprehensive nature of the construct and its considerable impact on other areas of an individual’s psychology and behaviour”, (Mercer & Ryan, 2010, p. 436).

Nevertheless, it is imperative to note that Dweck (2006a) asserts that there is a possibility for a learner to have both a fixed mindset and a growth mindset. That is, to have a fixed mindset in one domain and a growth mindset in another domain. For instance, a learner could, at the same time "believe that artistic ability is a fixed entity, you either have artistic talent or you do not, while they may believe that sporting ability is something that can be developed through concerted effort and practice" (Mercer & Ryan, 2010; p. 437). Simply put, it would be an oversimplification to conceive that a learner's mindset forms a simple dichotomy, i.e. either a fixed mindset or a growth

mindset. For instance, a learner who holds a mindset about learning of English language may perhaps differ from the mindset he/she holds about SFSCS learning. Hence, Yong (2017) argues that a learner's mindset changes over time. Yong further argues that a learner's mindset can be different in a domain of knowledge.

2.4.1 Comparing the two mindsets

According to Vandewalle (2012), a fixed mindset and a growth mindset create frameworks for interpreting and responding to the events that learners experience. For example, when a learner has a fixed mindset his/her (a) intelligence is a static trait, (b) low achievement on an intellectual activity is attributed fundamentally to a lack of intelligence and (c) perceived prediction to be successful on an activity is low. Learners who hold a fixed mindset believe that people are either smart or not. "When learners with a fixed mindset fail or make a mistake, they believe that they are just not smart and give up. Such learners frequently avoid challenges, preferring instead to complete easier work on which they know they will succeed" (Boaler, 2013, p. 143). However, a learner has a growth mindset when his/her intelligence, as well as low achievement, are perceived as an indication that there is a need for him/her to put (a) more effort and (b) a better strategy. With these approaches, the learner's potential prediction to be successful in an activity is much more hopeful. The implications of a growth mindset are profound: learners with a growth mindset "work and learn more effectively, displaying a desire for challenge and resilience in the face of failure" (Cherry, 2020; Rissanen, Kuusisto, Tuominen & Tirri, 2019; Sun, 2018; Haimovitz & Dweck, 2017; Boaler, 2013, p. 143).

Furthermore, Vandewalle (2012) underscores that mindsets do not only impact one's self-judgements, but equally impact judgements about other people. In comparing a learner who has a fixed mindset with another learner who has a growth mindset, the learner with a fixed mindset makes more quick judgments and forecasts about other people and situation(s). A learner who holds a fixed mindset is willing to do, judge and forecast with little information of just a single attitude he/she has observed or experienced. Another comparison between fixed mindset and growth mindset in terms of negotiation abilities, such as communication, planning and strategising, is that a learner with a growth mindset is more effective during learning: he/she discovers strategies that are more effective and becomes a high achieving learner (Vandewalle, 2012; Dweck, Chiu & Hong, 1995). Rissanen, Kuusisto, Tuominen and Tirri (2019) and Sun (2018) emphasise that learners who hold a growth mindset seem to be high achievers "during challenging school transitions and these learners' completion rates in demanding school subjects are greater" (Rissanen, Kuusisto, Tuominen & Tirri, 2019, p. 205). In the same vein, Tirri and Kujala (2016) assert that it has been found that learners who hold a growth mindset have higher achievement in the learning process, i.e.a growth mindset enhances performance in the learning process.

Haimovitz and Dweck (2017) assert that “a growing body of literature shows that the mindsets that people hold concerning learners regarding their intelligence and abilities can set the learners on different trajectories of motivation and learning” (p. 1). These patterns are seen in the learners’ academic achievement, such as holding more of a

growth mindset predicts better academic performance, particularly for learners that are facing challenges. For example, a study that surveyed all the Grade 10 learners in Chile reveals that the more a learner holds a growth mindset, the better he/she performed on their national standardised tests, irrespective of their economic status (Campbell, Craig & Collier-Reed, 2019; Haimovitz and Dweck, 2017; Tirri & Kujala, 2016). “This held true at all levels of socio-economic status (SES) and with effects comparable in size to economic variables” (Haimovitz & Dweck, 2017, p. 1).

A national study by Claro, Paunesku and Dweck, that explores seventy-five percent of all the learners in a Grade level in public schools, found that a learner’s growth mindset promoted his/her learning, whereas a learner’s fixed mindset hindered his/her learning. It indicates that a learner’s growth mindset is a strong forecaster of the learner’s achievement in learning. They also suggest that there is a positive relationship through all the socio-economic levels. However, a learner’s fixed mindset focuses him/her on avoiding his/her inability to demonstrate. This leads to a decrease in the learner’s performance in learning (Claro, Paunesku & Dweck, 2016). In the same vein, findings that are in line with Dweck’s theory have been initiated using a smaller sample in another society. Furthermore, recent studies’ findings reveal a negative outcome of a learner’s fixed mindset on his/her achievement in learning (Campbell, Craig & Collier-Reed, 2019; Destin, Hanselman, Buontempo, Tipton & Yeager, 2019; Zhang, Kuusisto & Tirri, 2017). Additionally, Romero, Master, Paunesku, Dweck and Gross’ (2014)

study shows that there is a substantial positive role of a learner's growth mindset improving his/her marks in the school subjects.

Zhang, Kuusisto and Tirri (2017) stress that learners' mindsets play the role of intermediary by linking the relationship between socio-economic levels and their achievement in learning. As such, learners who are with low-income background but hold a growth mindset display high academic performance (i.e. they are high-achievers), as a growth mindset substantially combats the impact of poverty on their achievement in learning and that learners' mindsets support the impact of a structural condition on a systemic level. This influences the learners' achievement in learning. A study found that a learner's fixed mindset controls the relation of independent functioning to his/her study effort and delays his/her homework. Likewise, a learner's fixed mindset negatively influences his/her well-being, personal energy and feelings of depression. This, in turn, directly influences his/her achievement in the learning process. For instance, a learner who holds a fixed mindset shows a low level of effort in studying and marks in quizzes. The development of a mindset (fixed mindset or growth mindset) is a function of a learner's prior achievement in learning as well (Zhang, Kuusisto & Tirri, 2017; Tirri & Kujala, 2016). Additionally, learners' mindsets and learning are related. It is evident that learning is a process of developing learners' mindsets. Learners' decisions as to whether to learn SFSCS to higher levels are based on their mindsets regarding the subject and its learning. This is because learners' mindsets come forward in the learning process of SFSCS and the way learners perceive themselves supports

them to pursue certain types of learning and to reject others (Campbell, Craig & Collier-Reed, 2019; Zhang, Kuusisto & Tirri, 2017, p. 1369; Claro, Paunesku & Dweck, 2016).

2.4.2 Interventions for changing mindsets

Rissanen, Kuusisto, Tuominen and Tirri (2019) argue that fixed and growth mindsets are relatively stable. However, mindsets can "be altered by educational interventions as even brief interventions have had long-lasting effects on learners' motivation and achievement" in the learning process (p. 205). Hence, Zion and Crum (2018) affirm that "mindsets can be intentionally and adaptively changed through targeted interventions" (para. 3). Boaler (2013) affirms that several studies reveal the effects of growth mindset interventions on learners' achievement in the learning process. For instance, a multiple intelligence intervention and a no-treatment control with learners who received a growth mindset treatment were conducted. The control groups of learners did not exhibit any change in achievement, whereas the growth mindset intervention led to gains in achievement, especially for the Black learners. After the intervention, the differences in achievement between the White learners and Black learners were less. The Black learners who were in the growth mindset group revealed a substantial increase in their interest, valuing and enjoyment of the subject in the learning process (Boaler, 2013). Following this, the influence of race on learning will be discussed in detail later.

Considering the above, interventions that teach learners with a growth mindset can improve the learners' "achievement over time suggesting the fundamental role of these

mindsets in enhancing the learners' motivation plus their achievement" in learning. More so, these interventions represent a powerful means of transmitting a growth mindset to learners. "The interventions teach a growth mindset by transmitting the ways learners' brains [and hence intelligence plus abilities] can grow stronger over time by taking on hard tasks and persisting" in learning (Haimovitz & Dweck, 2017, p. 2). More so, a teacher can shape his/her learners' perceptions of their own abilities and influence their motivation and achievements in learning. A teacher who holds a fixed mindset always praises his/her learners' abilities or comforts his/her learners for their inadequate ability when they fail. This may affect the learners' motivation and perseverance in learning (Campbell, Craig & Collier-Reed, 2019; Rissanen, Kuusisto, Tuominen & Tirri, 2019; Haimovitz & Dweck, 2017; Boaler, 2013).

Boaler (2013) argues that an intervention for learners with a growth mindset halted the learners' marks from declining and placed learners on another pathway of improvement, leading to high achievement in learning. "The crucial growth mindset message was that effort changes the brain by forming new connections and that learners control this process" (p. 144). Boaler further argues that an intervention was created for some learners who hold a growth mindset and compared it to a control group. In the two groups, the teachers were made to meet with their learners physically for one and a half hours and then again (for one and a half hours) after about ten weeks. Every other communication between the teachers and learners was via email. At the end of the exercise, the growth mindset intervention led to a "4.5-point gain in SFSCS

achievement test scores and a 4-point gain in reading achievement test scores. In the control group, there was a highly substantial gender difference in SFSCS, yet, in the growth mindset group, the gender gap" was eliminated to a huge extent (Boaler, 2013, p. 144). Following this, the influence of gender on learning will be discussed in detail later.

With the above in mind, mindsets can be socially constructed. Most importantly, the fixed and growth mindsets can be learned. Hence, studies found that the classroom is a setting for learners' mindset to be socialised. Yet, ample socialisation does only not take place in the classroom between a teacher and a learner, but through the formation of cultural rules. These imply that learners' mindsets can be influenced by the learners' peers, teachers and even parents as well. To this end, if learners' mindsets are positive, they are likely to have positive experiences. In the same way, if their mindsets are negative, their experiences tend to be negative. However, what constructs mindset is something that we need to look at.

Ensuing from a critical understanding of the definitions above, I conceptualise the definition of mindsets for this present study as the beliefs people hold about intelligence and abilities in the learning process regarding a SFSCS. Furthermore, anyone who believes in the central importance of a gift or natural talent for success is termed to hold a fixed mindset, while anyone who has faith in the power of efforts and hard work to positively affect learning abilities is termed to hold a growth mindset. Furthermore, the above also indicates the importance of social relations on mindsets (Cherry, 2020; Sun,

2018; Haimovitz & Dweck, 2017; Boaler, 2016; Mercer & Ryan, 2010; Mercer & Ryan, 2009; Dweck, 2006a & 2006b; Bernstein, 1973 &1971). To this end, mindsets are of two types: fixed and growth; and mindsets are influenced and constructed socially.

2.4.3 Importance of studying mindsets

Yeager and Dweck (2012) assert that learners' mindsets forecast the learners' academic performance over a period, especially when learners are facing a challenging task(s) in the learning process. The two mindsets of intelligence appear to create different psychological worlds for learners, such as one that "promotes resilience and one that does not. The fixed mindset world is about measuring one's ability and everything (i. e. challenging tasks, effort, setbacks) measures your ability" in learning (Yeager & Dweck, 2012, p.304). This is a world of threats and defences. "The growth mindset world is about learning plus growth and everything (i. e. challenges, effort, setbacks) is seen as being helpful to learn and grow" in learning. This is a world of opportunities to improve or grow (Destin et al., 2019; Yeager & Dweck, 2012, p.304).

Zhang, Kuusisto and Tirri (2017) affirm that past studies that explore the relationships between learners' mindsets and their (learners) performance in learning reveal that their mindsets have a vital role in learning, as learners' mindsets affect their learning, which is evident in Dweck's theory of mindsets. As theorists in education increasingly believe that learning is linked to the social and cultural contexts within which the learning takes place and that learning involves a cognitive process, an emotional and a socio-cultural

process, exploring learners' mindsets is a way of broadening the researcher's understanding of the essential theories and practices in education. In the intersection of social cognitive dimension, mindsets can be used to forecast several aspects of learners' achievement, including academic (learning), cognitive, motivational, affective and even socio-economic. In other words, a learner's mindset is perceived mostly as an independent variable that forecasts the dependent variables (i. e. attributes, dispositions and achievement) in learning (Destin et al., 2019).

Learners' mindsets are also frames of mind that orient the learners to particular sets of expectations in the learning process - this enhances learners' understanding of what they learn and perhaps the provision of some insights on how persistent issues, such as learners' negative attributes and dispositions (like disengagement and non-participation in learning) are negatively influencing learning, as well as providing possible approaches for tackling the issues (Destin et al., 2019; Zion & Crum, 2018; Zhang, Kuusisto & Tirri, 2017; Claro, Paunesku & Dweck, 2016; Darragh, 2016; Tarhan & Balban, 2014; Boaler, 2013; Heyd-Metzuyanim, 2013; Nasir & Cooks, 2009; Grootenboer & Zevenbergen, 2008; Gee, 2000).

Haimovitz and Dweck (2017) assert that research reveals that fixed and growth mindsets position learners in the direction of diverse goals, diverse perspectives of effort and diverse responses to setbacks. In this light, it is crucial to note that it is through these processes that fixed and growth mindsets influence learning. More so, the mindset that a learner holds provides an important framework for understanding the

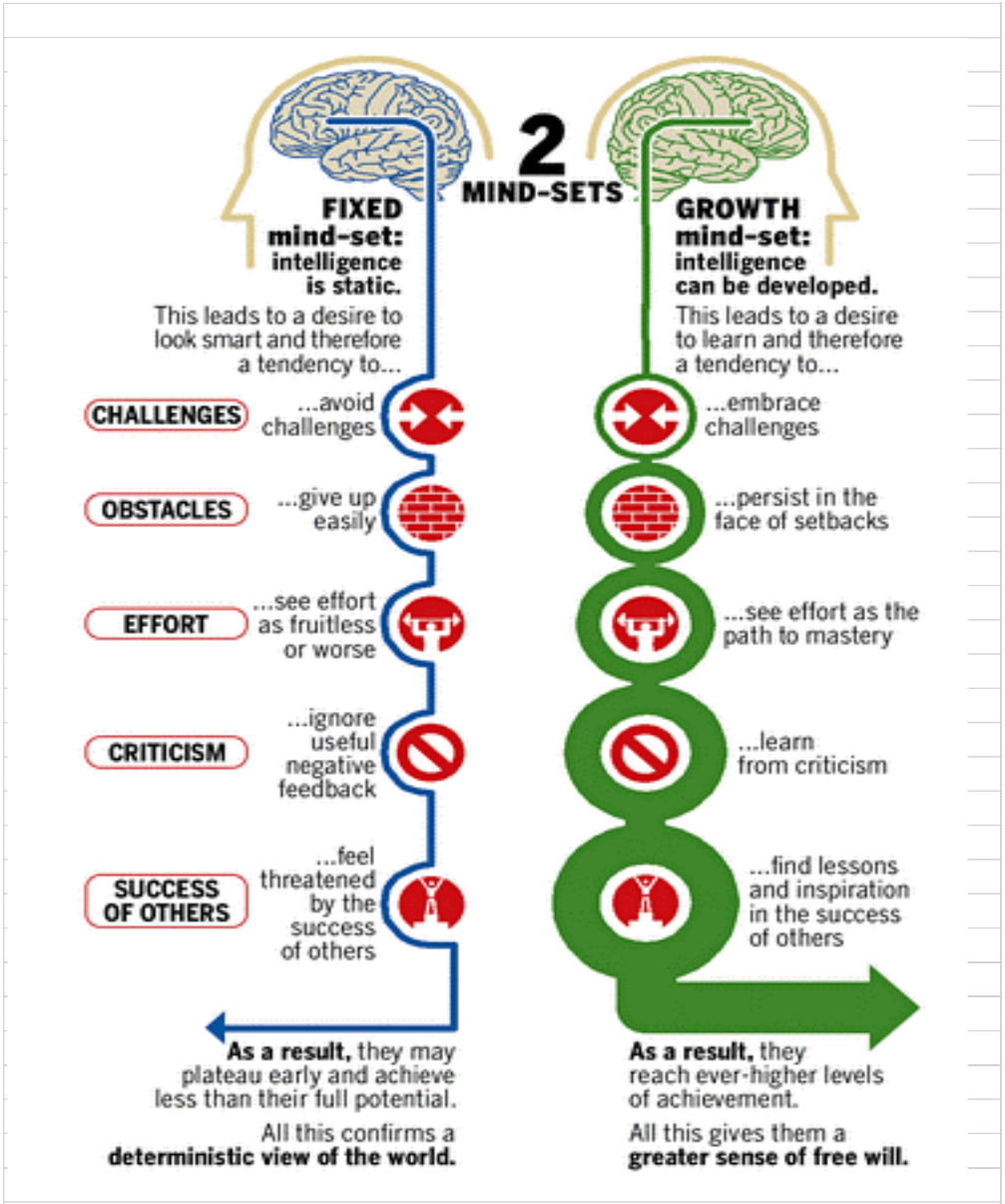
learner's motivation and behaviours that are related to learning (Haimovitz & Dweck, 2017; Tirri & Kujala, 2016). In addition, the different mindsets (fixed and growth mindsets) have made available a reason why learners who possess equal abilities given the same condition(s) possess different goals of achievement plus patterns of behaviour, as well as consequently displaying distinctions in the process of learning and learning outcomes (Bernecker & Job, 2019; Rissanen, Kuusisto, Tuominen & Tirri, 2019; Haimovitz & Dweck, 2017, p. 2; Dweck, Chiu & Hong, 1995).

Another important advantage of learners' mindsets in understanding learning is that it does not only focus on learners' cognition, incentives, performance, or achievement, but also focuses on the learners, their environment and how they learn (Destin et al., 2019; Boaler 2016). For instance, the effective learning of SFSCS is a function of the learners' mindset toward the subject. The prior, current and anticipated learners' experiences of learning are important, potent tools in acquiring in-depth knowledge and understanding of the learners' mindsets and his/her learning (Boaler, 2016; Darragh, 2013; Nasir & Cooks, 2009). Drawing on these, learners' prior, current and anticipated experiences will influence the their mindsets in the process of learning; and learning is the basis of the mindsets they hold about learning itself (Haimovitz and Dweck, 2017). Hence, learners' mindsets (fixed and growth mindsets) influence their learning and the mindset that a learner holds provides a crucial basis for understanding their motivation and behaviours that are related to learning. Learners' mindsets are not static entities, but rather are entities that are constantly influenced by messages and experiences in one's

context. These suggest as well that learners' mindsets are socially constructed in the process of learning, as they (mindsets) are also constructed based on the stimuli they have from their environments (Destin et al., 2019). This will be discussed later in the present study.

Zhang, Kuusisto and Tirri (2017) further affirm that the causal role of learners' mindsets in their achievement in learning was primarily reflected through intermediate variables, such as a learner's growth mindset, which forecasted a higher achievement in his/her learning with the aid of the intermediate variables of goal setting (e.g. goals of performance and learning), goal operation (e.g. mastery and helpless oriented strategy) and goal monitoring (e.g. negative emotion expectations). More so, in Greek studies, the role of a learner's mindset in his/her achievement was realised through perceived competence. This is viewed as a salient variable that links the learner's mindset with his/her achievement in learning. These outcomes are consistent with Dweck's (2000) conclusion that the influence of a learner's mindset is interceded by perceived performance in the learning process (Zhang, Kuusisto & Tirri, 2017; Dweck, 2000). As such, there is therefore a link between learners' mindsets (fixed mindset and growth mindset) and learning.

Figure 1 summarises some of the key qualities of a fixed mindset and a growth mindset.



Source: *Image:* *Nigel Holmes* */ Graph Content:* *Carol Dweck*
(Appell, 2019 para. 5; Popova, 2014, para. 3)

Figure 1: A summary of the two mindsets

To a large extent, the figure depicts a summary of mindsets theories (MSTs) as discussed above. Figure 1 shows some fundamental tendencies of learners who hold the

two mindsets, such as fixed mindset and growth mindset. The figure further illustrates some of the tendencies of a learner who holds a fixed mindset (i.e. he/she believes intelligence is static) and this leads to a desire for him/her to look smart and, consequently, a tendency for the learner to (a) avoid challenges, (b) give up easily on a task, (c) see effort as fruitless or worse, (d) ignore useful negative feedback and (e) feel threatened due to the success of other learners. The possible outcome of learners with these tendencies is that they may plateau early and achieve less than their full potentials, that is, become a low achiever in learning. On the other hand, the figure equally illustrates some of the tendencies of a learner who holds a growth mindset (i.e., he/she believes intelligence can be developed), which this leads to a desire for him/her to learn. Consequently, a tendency for the learner to (a) embrace challenges, (b) persist in when faced with setbacks, (c) see effort as the path to mastery, (d) learn from criticism and (e) derive lesson and inspiration from the success of other learners. The possible outcome of learners with these tendencies is that they become high achievers in learning (Appell, 2019; Popova, 2014).

2.5 Attributes that co-construct learners' mindsets in the context of learning of SFSCS

Multiple attributes incorporate learners' lives and attribute influence learning. As such, this section reviews studies on learners' attributes and their influence on the learning of SFSCS. These attributes include race and gender. Racialised and gendered learners are

socially constructed in the educational system, through discourses, dialogue, engagement and negotiation. A concern with learners' attributes (or in some theoretical traditions, subjectivity) underscores the understanding that socio-economic, political and cultural markers, such as race, gender and class, are critical in making sense of learners' activities in the learning process. Reyes and Stanic (1998) argue that the disparities in learners' achievement in the learning process are based on race, gender and socio-economic status (SES). As a result, Reyes and Stanic affirm that the disparities in learners' achievements in learning cannot be properly and adequately understood if race, gender and SES are not studied as well. SES is essential in understanding the issues related to race and gender in learners. However, the effects of race thinking and acting, as well as gender issues in learning, are important to consider as well. (Bishop, 2012; Parks & Schmeichel, 2012; Robinson, 1999).

It is noteworthy here that some attributes, according to Bishop (2012), can "reference fixed attributes - race, gender and socio-economic status (SES) or arise based on social relationships; they can also look toward the past, present, or future". Fixed attributes are those attributes that do not change, i.e., attributes that are stable. Attributes could coexist in a learner (pp. 37 – 38). Some learners' fixed attributes, such as race and gender, influence their academic achievement in strongly framed and strongly classified subjects in the learning process.

2.5.1 Influence of race in relation to learning.

Parks and Schmeichel (2012) assert that socio-political projects support the focus on racism – the ideology and practice of marginalisation of some groups of people because of their race. Parks and Schmeichel (2012) further assert that racism could inform the analysis of a variety of contexts related to strongly framed and strongly classified subjects, comprising the documenting of microaggressions, such as an assumption of "a teacher that a book possessed by a Black learner must have been a stolen one; or the analysis of more macro forces - such as the variety of privileges being White affords the learner in most" SFSCS classrooms (p. 239). This assumption would presume or use race as an issue in the learning process, thus creating an avenue for looking at the development of racialised learners' personalities, as well as certain perceptions and attitudes towards the learning of SFSCS. In a study with Black and White learners in America, Lubienski (2002) found that some differences in learners' mindsets could be related to both learning and its achievements in SFSCS. Lubienski found that Black learners tended more than White learners to agree with the statements that there is only one way in order to solve a SFSCS problem, SFSCS learning is primarily memorising facts and SFSCS learning is a complex, headache-inducing, confusing and daunting task (Gholson & Martin, 2019; Uwerhiavwe, 2014; Tshabalala & Ncube, 2013; Bernstein, 1971).

Race remains a substantial aspect of academic achievement in SFSCS and its learning (Orr, 2003). In this regard, Martin (2000) argues that the results derived from large-

scale tests of SFSCS achievement in learning, such as the “National Assessment of Education Progress (NAEP) indicate that Black learners usually score below their peers in all content areas of SFSCS. Moreover, these achievement differences grow as the topic areas increase in complexity” (p. 10). Based on the gap in test scores among Black and White learners, Lubienski (2002) asserts that there were controversial claims about SFSCS achievement gaps between Black and White learners. Achievement gaps could be eliminated with proper attention to issues related to schooling and family support. This has a positive consequence for learners’ mindsets as it affords learning of the subject, which is associated with a growth mindset because it is positive.

Lubienski (2002) emphasises that attempts to statistically equate Black and White learners were difficult, because of some differences between their experiences in schooling and family support. Lubienski (2002) further emphasises that attempts to statistically equate Black learners and White learners were difficult, because some differences between their experiences were a matter of quality and not simply differences in degree. Consequently, "achievement tests used as the dependent variable are often biased toward traditionally high-achieving learners who are disproportionately White" (p. 269). Rohn (n.d.) argues that, based on race, given the same situation, learners could be expected to experience education differently because of theirearners’ socio-economic status (SES), background and other factors. Black learners tended to experience a lower form of education, such as less qualified teachers, fewer course offerings (for instance, SFSCS content), less culturally responsive teaching and lower

teacher expectations (Simon & Ainsworth, 2012). Hence, Martin (2000) points out that it is not a surprise that the Black learners are probably experiencing less access and exposure in terms of quality educational resources, such as modern school facilities, qualified and experienced teachers, computers, advanced classes, small classes and enrichment activities (Simon & Ainsworth, 2012). This has a negative consequence for learners' mindsets, as it constrains learning and is linked to a fixed mindset because it is a hindrance to learning.

In Martin's (2009) book chapter with the title: "Liberating the Production of Knowledge about African American Children and Mathematics", he details the way in which the prevailing manners of construction and narratives of Black learners, as well as SFSCS, have developed out of an approach of race-comparative. An ample knowledge base on Black learners and SFSCS entailed summarised reports that documented the learners' performance in achievement tests regarding other learners, particularly the White learners, whose behaviours (for example, mathematical behaviour) and outcomes are typically normalised as the standard for all learners". Black learners, as well as their capabilities, frequently continue to be constructed in ways that are negative and damaging. Black learners' poor achievement, as well as failure in SFSCS and its learning, have been emphasised over "success plus resilience", the capability to recover from failure (Martin, 2012, p. 48). However, according to Martin (2012), there is an overriding narrative about Black learners and SFSCS which likewise involved "a fixed set of cultural and cognitive explanations for negative outcomes, including cultural

differences or deficits, family background and socio-economic status, oppositional orientations to schooling", as well as inadequate SFSCS knowledge and problem-solving skills, (p. 48). This has a negative impact on learners' mindsets as it constrains learning. It relates to a fixed mindset, as it is negative.

Martin (2012) posits that learning and teaching of SFSCS research and policy are intensely involved in racialised constructions of who is seen as literate or illiterate in the learning of SFSCS. More so, about two and a half decades ago, SFSCS learning and teaching policy reports considered Black learners illiterate in SFSCS and its learning. These constructions are both empirical and ideological. Martin (2012) further posits:

> it is unfortunate that some policymakers and researchers occasionally lose sight of this fact by confining Black learners' existence to a single, pathological set of material and cultural circumstances, such as (a) at-risk, (b) poverty-ridden communities, (c) ghettos, (d) dysfunctional families and (e) oppositional stances toward schooling. Ignoring historical and structural considerations, we are asked to believe that genetic, cultural and intellectual inferiority account for these conditions [i.e., a fixed mindset]. High-poverty contexts plus ghettos are not natural contexts for Black learners and such circumstances should not be normalized in studies of their mathematical development. Like Slavery and Jim Crow, these contexts are 'race-making institutions' designed to dehumanize and inflict material, structural and symbolic violence on those who are forced to live in them (p. 51).

There is this claim that almost all learners who are from backgrounds of low-income go into school with extremely less knowledge than their counterparts, who are from backgrounds of middle-income or high-income. Swanson (2002) shows that Black learners, who were given entry into a high-status school with the support of a Black scholarship programme, were viewed socially as being disadvantaged. These learners were given scholarships because they showed potential in their urban schools. As these

learners were of different socio-economic status (SES) from the other learners in the high-status school, they were regarded as being disadvantaged. The learners were therefore socially constructed as being disadvantaged because they were experiencing educational opportunities that had restricted them from learning effectively. These learners thus perceived themselves negatively (i.e. learners who were deficient in certain qualities unable to understand SFSCS effectively, unlike their counterparts from the high-status school). This negatively affected their mindsets and subsequently negatively influenced their achievements in learning of the subject. This is linked to a fixed mindset, as it constrains learning of the subject.

I further reviewed more literature on race in relation to learning and achievements, as shown in Table 2.1 (Martin, 2006; Nasir & Hand, 2006; Reyes & Stanic, 1998). The table shows a summary of the literature I reviewed. I have made use of tables (Tables 1, 2, 3, & 4) in grouping the literature to enable a more organised review, logical and coherent focus on the primary literature under review, as well as easy reference.

Table 1: Research studies on race in relation to learning

S/N	Author(s) and Year of Publication	Research Methodology, Method(s), Participants	Focus of the Study	Findings
1	Martin (2006)	A research article: draws on three ethnographic and participant observation studies.	Learners' performance in learning secondary school.	Learning and participation can be conceptualized as racialized forms of the learners' experience.
2	Nasir and Hand (2006)	A research article: explores sociocultural theoretical perspectives for integrating and further developing research on race, culture, and learning.	Sociocultural theory, race, culture, and learning.	Race as a social construction can be considered be treated as an identity that individuals negotiate with respect to the social categories that society offers them.
3	Reyes and Stanic (1998)	A research article: explains group differences in learners' performance in with a model.	Variables attributed to group differences in achievement in learning.	A learner's achievement in learning differs depending on socioeconomic status (SES) and other factors.

The three research articles in Table 1 (Martin, 2006; Nasir & Hand, 2006; Reyes & Stanic, 1998) reveal that disparity in learners' achievements in the learning process was not attributed to the learners' race per se, but to some factors, such as mindsets, beliefs, opportunities and access to learning based on the learners' socio-economic status (SES).

Martin (2006) asserts that "race has dubious value as a scientific classification system" as it has had substantial consequences in Blacks' experiences and opportunities in the United States. Race is a socially constructed concept and it is a defining attribute for Blacks' group membership (p. 197). In general, Martin (2006) views race as socially, politically and relationally constructed so that some salient issues, such as marginalisation, power, dominance and devalued social status assume prominence. Martin (2006) further asserts that many parents [who are Black] placed their fight for SFSCS learning "within race-based frameworks that they believed characterised their

lives and their children's lives", as both Blacks and learners of SFSCS. Many parents articulated "a kind of racial realism signalling a belief that race will always be a salient marker for meaningful participation in society at large", as well as SFSCS and its learning (p. 202).

Nasir and Hand (2006) use literature on socio-cultural theory, race, culture and learning, which is critical in exploring and extending a collective understanding of how race and culture matter for learning. As such, Nasir and Hand likewise assert that race is socially constructed. Race being a social construction can also be regarded as being constituted by a "loosely defined organization of cultural practices that play out differently in different contexts. At the same time, it can also be treated as an attribute that learners negotiate with respect to the social categories that society offers them" (p. 463). This has consequences for learners' mindsets. For instance, learners who hold a growth mindset perform better in a SFSCS, because they have an empowering [or positive] perspective about SFSCS learning. More so, they focus on viewing and improving effort as an avenue to develop their abilities; as such they view failure as a part of the learning process of the subject.

Reyes and Stanic (1998) present a model to explain a theoretical framework that underlies the model and differences in learners' achievement in learning based on race, gender and socio-economic status (SES). Hence, Reyes and Stanic affirm that socio-economic status is very important in understanding issues regarding race and gender in the learning process. Reyes and Stanic further affirm that, for every member of a

society, SFSCS knowledge is very important (Obomanu & Adaramola, 2011). Unfortunately, some groups are underrepresented in SFSCS learning. They do not achieve their potential. Black learners are among this group. They are learners of low SES, which will prevent the learners from having equal opportunities and access to quality [SFSCS] education, coupled with the other factors [induced by their low SES] for effective SFSCS learning, unlike their counterparts with high SES. This low SES of the learners will have a negative influence on the learners' mindsets and consequently their achievements in the learning of SFSCS. Hence, Reyes and Stanic (1998) assert that the achievement scores of SFSCS of Black learners are constantly lower, when compared to White learners in the Assessment of the National Assessment of Educational Progress. This assertion will have an impact on learners' mindsets as well. That is, it will have a negative impact on the learners, thereby constructing a fixed mindset, which in turn, influences their learning, negatively.

Drawing on the above, it is important to note that Black learners and Whites learners' disparities in achievements in learning are a result of these points by Martin (2006), Nasir and Hand (2006), as well as Reyes and Stanic (1998): the opportunities, access, parental support, environment (society) and other factors [due to their SES] in order to learn effectively. These analyses by Martin, Nasir and Hand, as well as Reyes and Stanic, are applicable to South Africa. However, some studies conducted in South Africa emphasise the risks of classifying learners based on their race, as well as attributing the learners' achievements in learning to their background (Swanson, 2002;

Skovsmose, 2005). Nevertheless, classifying learners on a racial basis and attributing their (learners) academic achievements to their background have an impact on the learners' mindsets.

Skovsmose (2005) concurs with Martin, Nasir and Hand and Reyes and Stanic's statements by arguing that race does not prevent a learner's capability to learn effectively, but factors, such as poor conditions of the classroom, lack of qualified teachers, insufficient availability of learning resources and the school in general, negatively influence the learner's achievement in the learning process. Skovsmose maintains that the dilapidated condition of a classroom is a barrier to effective learning as it showed the background and the SES of the learners in that school, as well as the learning opportunities which have been offered to the learners by society, which influences the mindsets learners hold concerning learning, that is the learners will develop a fixed mindset, which constrains their effective learning.

Not any of them (Martin, 2006; Nasir & Hand, 2006; Reyes & Stanic, 1998) has ever said that these learners are without any ability in learning of SFSCS. They indicate that the socio-economic (SES) position of the learners, the ways in which they have been positioned in the society, what they (learners) have got access to, the way they have been marginalised and the support they get are what inform and influence their beliefs and performance in learning. Race is impacted and constructed on all those levels. This influences the learners' mindsets. It is noteworthy to state at this juncture that race

establishes in them a fixed mindset which is negative, since learners are generalised, equal in relations and discriminated against.

2.5.2 Influence of gender in relation to learning.

Gender is another common and fundamental part of learners' attributes, which is discussed in the literature to a large extent below. It is noteworthy that, despite the claims about achievement gaps between Black and White learners, there are also some claims about achievement gaps in connection with the intersection of race and gender (i.e. between Black learners – Black males and Black females, as well as between White learners – White males and White females. For instance, Blundin (2013) argues that "males are generally more capable in the logical-mathematical category, BUT (this is a significant BUT) females have been gaining ground in these areas - such as having good knowledge of mathematics and performing highly in mathematical learning over the last twenty years" (p. 1). This excerpt is a function of the fixed mindset that has been developed. With the above in mind, I further discuss reviewed studies on gender in relation to SFSCS and academic achievements, as well as mindsets in the learning process, as shown in Table 2 (Radovic, Black, Salas & Williams, 2017; Ali, Bhagawati & Sarmah, 2014; Uwerhiavwe, 2014. The table shows a summary of the literature I have reviewed.

Table 2: Research studies on gender in relation to learning

S/N	Author(s) and Year of Publication	Research Methodology, Method(s), Participants	Focus of the Study	Findings
1	Radovic, Black, Salas and Williams (2017)	Qualitative research: A case study approach: observation and interview with 39 learners and 1 teacher (the learners' teacher).	The process of learners' personalities construction of three learners (girls) belonging to three different peer clusters in one classroom.	Confirmed that among girls who share a positive relationship with the activity of SFSCS, i. e. a high level of achievement and engagement with the practice, there is a vital variability in how the learners' personalities are experienced in the classroom.
2	Ali, Bhagawati and Sarmah (2014)	Quantitative research: a questionnaire - 120 learners (60 females and 60 males) as respondents.	The learners' performance in secondary school.	Learners' poor performance in SFSCS due to poor foundation of basic knowledge and lack of the willingness and readiness to learn. Gender difference - females' performance is seen very poor when compared to males.
3	Uwerhiavwe (2014)	Qualitative research: (i) observational field notes, and (ii) interview with teachers and learners.	The factors which contribute to performance in SFSCS education.	Learners' performance is attributed to effective teaching, learners' attitudes, mindsets, interest, determination, willingness, gender difference, and beliefs.

Gender is informed by sexist assumptions about the ability of women: that women are emotional and men are rational. This has an impact on their ability to do SFSCS (Magaldi, 2015; Feingold, 1992). Hence, gender difference is a part of learners' attributes. However, Haimovitz and Dweck (2017) affirm that the beliefs about intelligence and abilities that people hold are how they understand learners and establish paths for learning. In line with this, Dweck and her colleagues found, in a study, that gender differences in SFSCS performance only existed among learners who hold a fixed mindset. The study likewise found that "learners who are females, in particular, are damaged by fixed ability messages that imply that some learners are smart and some are not, which contributes to the low numbers of women continuing" in SFSCS and science

(Boaler, 2013, p. 147; Dweck, 2006b). In the same vein, Tirri and Kujala (2016) assert that learners who are females hold a fixed mindset and are "more likely to be affected by the stereotypical beliefs (fixed beliefs) and this subsequently leads to declines in female performance in SFSCS" and subjects and skills that are related to SFSCS (p. 1232). As such, the present study likewise explores gender [as one of the learners' attributes] in the learning process of SFSCS.

Ali, Bhagawati and Sarmah (2014) reveal, in a quantitative study, that a learner's gender influences his/her performance in the learning of SFSCS. Females' performance was very poor compared to males. This assertion is based on a fixed mindset they hold concerning SFSCS learning. Prior to Ali, Bhagawati and Sarmah's (2014) quantitative study, Maliki, Ngban and Ibu (2009) posit that there was always an indication of the influence of gender in the performance of learners in the learning of SFSCS. They noted that male learners obtained a higher mean score than their female counterparts in the learning process of SFSCS. On the contrary, Chisholm and September (2005) assert that a decade after South Africa's democratic elections, research and social action on gender equity in South African education show that the quality of females' engagement in schooling and their outcomes were better overall, compared to males. There is a backlash because males are now underperforming in terms of learners' retention, engagement and achievement on the basis of equal access to every aspect of education, especially in the zones, such as SFSCS, where the males dominated (Chisholm &

September, 2005; Kenway, 2005; Pandor, 2005). Similarly, these assertions are a function of a fixed mindset they hold in relation to learning.

For the past few decades, a lot of research has recorded the way females have been experiencing and tackling underperformance in SFSCS and its learning as a group. Also, after elementary SFSCS [i.e. in pure mathematics] which are compulsory, females are participating less when compared to the males, who have been shown to be “better able to reposition their goals by pursuing competition and relative success without disengaging from” SFSCS and its learning. On the other hand, females have been observed to find “this repositioning more difficult, thus tending toward disengagement and disidentification from” SFSCS and its learning (Radovic, Black, Salas & Williams, 2017, p. 436). Radovic, Black, Salas and Williams's (2017) study found that gender seems to intercede female learners’ relationships with SFSCS in the learning process.

Radovic, Black, Salas and Williams (2017) further found that gender intercedes in female learners’ relationships in the learning process of SFSCS, through (i) their interactions with their peers. These female learners are "getting themselves prepared for "future (gendered) relations that influence their relationships with” SFSCS ‘at the moment’ in classrooms and (ii) their choice of studying SFSCS “as a career path – peer groups are not only a space of belonging but also a space for becoming”. Radovic, Black, Salas and Williams likewise found that the discourse of natural ability as male learners appears to be a basis from which “some females might draw to negotiate their difficulties” (p. 458) The focus and analysis of Radovic, Black, Salas and Williams’

(2017) study were solely on the three females (p. 444), whereas both males and females participated. As such, a substantial comparison between the males and females on the ability in SFSCS and its learning was not explicitly defined in their study.

Uwerhiavwe (2014) indicates, in a qualitative study, that every learner [male or female] learns SFSCS equally, if all learners have an equal opportunity and conditions for SFSCS education (i.e. the learning of SFSCS), which is, however, not possible. It is interesting to note that there are several studies on gender, as well as SFSCS and its learning, which show that what was once an alarming gender gap in SFSCS: "achievement and participation in its learning have been reduced to a few or no percentage points. In school achievement, females now typically fare as well as males" in SFSCS. This is a remarkable change from earlier times (Ontario Ministry of Education, 2004, p. 33). In the same way, as well as with regards to the aspect of equal access of learners to SFSCS education on the basis of gender, Subrahmanian's (2005) paper on gender in education in South Africa affirms that "quantitative indicators of progress suggest that gender gaps in access to a variety of public goods are closing. This is broadly true of schooling as well" (p. 29). This influences the mindsets learners have about SFSCS and its learning.

2.6 Learners' dispositions and their influence on learning

Mindsets are also about dispositions (Zhang, Kuusisto & Tirri, 2017; Tirri & Kujala, 2016; Yeager & Dweck, 2012). Learners' achievements in the learning process of

SFSCS are ascribed to various dispositions of the learners, such as beliefs, attitudes and abilities. To this end, this section reviews studies on the influence of learners' dispositions on the learning of SFSCS, such as attitudes, beliefs and perceptions toward the learning of SFSCS, as well as confidence and competence of learners in the learning of SFSCS. Table 3 shows a summary of literature related to learners' achievements and learning of SFSCS that I reviewed.

Table 3 Research studies on learners' characteristics and influence on learning

S/N	Author(s) and Year of Publication	Research Methodology, Method(s), Participants	Focus of the Study	Findings
1	Heyd-Metzuyanim (2013)	Qualitative research: interview with 12 grade 7 learners.	Construction of a failure personality in SFSCS of an extremely low-achieving learner.	The failure of a learner in the learning of SFSCS; despite the necessary intervention, the learner's achievements did not improve.
2	Tshabalala and Ncube (2013)	Quantitative research: a questionnaire (open and close ended), with 200 learners.	Learners' attributions of high failure in SFSCS examinations.	Learners' failure attributed to their strong belief, perception, absenteeism, competency and family.
3	Mbugua, Kibet, Muthaa and Nkonke (2012)	Quantitative research: questionnaires with 132 teachers, 9 head teachers.	Socio-cultural and personal factors that affect learners' performance in SFSCS in secondary schools.	Learners' poor performance in SFSCS attributed to personal factors, cultural and parents' background.
4	Maliki, Ngban and Ibu (2009)	Quantitative research: an inferential survey design to describe existing phenomena with 600 learners.	Secondary school learners' performance in SFSCS test.	Learners' test scores in SFSCS were high; though, the male learners obtained higher mean score than their female counterparts.
5	Boaler, William and Zevenbergen (2000)	Qualitative research: interview with 120 learners.	The practices of secondary school SFSCS teaching from the perspectives of the learners.	Learners try to negotiate conflicting constraints in developing their personalities in SFSCS learning.

In the above literature, low and high achievements of learners in SFSCS are attributed primarily to the learners' attitudes, beliefs and perceptions, which are features of learners' mindsets as well. It is worthy of note to reiterate here that mindsets are about dispositions: attitudes, beliefs and perceptions. As such, the studies reviewed in this section are those that focus primarily on the three learners' dispositions, such as attitudes, beliefs and perceptions, as well as the influence the dispositions have on learners' achievements in SFSCS and its learning. The first three studies in Table 3 (Heyd-Metzuyanim, 2013; Tshabalala & Ncube, 2013; Mbugua, Kibet, Muthaa & Nkonke, 2012) reveal various reasons for learners' poor achievement in SFSCS and its learning. Some of the reasons are the learners' mindsets, beliefs, perceptions and competency regarding SFSCS and its learning, as well as the cultural and background they have. The fourth study (Maliki, Ngban & Ibu, 2009) found that there is a good learners' achievement in SFSCS learning and that if a learner has a positive attitude towards SFSCS and its learning, this will reflect in his/her performance in the subject. In the last study, Boaler, William and Zevenbergen (2000) assert the influence learners' perceptions have on their achievement in SFSCS learning. The three attributes, - attitudes, beliefs and perceptions, are briefly discussed below.

2.6.1 Learners' attitudes towards learning

As mentioned above, mindsets are about attitudes. In a quantitative study, Tshabalala and Ncube (2013) found that high failure rates in SFSCS and its learning can be attributed to learners' attitudes - such as the absence of learners' interest, willingness

and determination, and their anxiety toward SFSCS and their learning of SFSCS. The high failure rates are a consequence of the learners' negative attitudes toward SFSCS and its learning (Uwerhiavwe, 2014). Learners' attitudes toward SFSCS and its learning have huge impacts on their achievement in the learning of SFSCS. Maliki, Ngban and Ibu (2009) assert that attitude predicts behaviour. Accordingly, it can be inferred that the perceived difficulty of SFSCS and its learning by some learners is because of their negative attitude towards it. This is evident in a learner who holds a fixed mindset. If a learner has a negative attitude towards SFSCS and its learning, then this will reflect negatively on his/her performance in the subject (Maliki, Ngban & Ibu, 2009). More so, this negative attitude relates to the learner's mindset (fixed mindset). This is a pointer to the notion that mindsets are about attitudes.

In a quantitative study with an inferential survey design describing existing phenomena, Maliki, Ngban and Ibu (2009) found that high achievement in SFSCS and its learning could be attributed to the learners' positive attitudes toward SFSCS and their learning of SFSCS. Invariably, it can also be inferred that the perceived "easy-going" of SFSCS and its learning by some learners is because of their positive attitude towards SFSCS and its learning. This is evident in a learner who holds a growth mindset. If a learner has a positive attitude towards SFSCS and its learning, then this will reflect positively in his/her performance in the subject (Maliki, Ngban & Ibu, 2009). As mentioned above, mindsets influence learners' attitudes towards SFSCS and its learning (Dweck, 2013c; Carey, 2012; Vermeer, 2012b): a positive attitude towards SFSCS and its learning

relates to the learner's mindset as well. Also, this is a pointer to the standpoint that mindsets are about attitudes.

2.6.2 Learners' beliefs about learning

Mindsets are also about beliefs. Some learners have a strong belief that SFSCS and its learning are naturally difficult, a daunting task and are meant for the intelligent and talented learners. These are learners who hold a fixed mindset (Ali, Bhagawati & Sarmah, 2014; Uwerhiavwe, 2014; Tshabalala & Ncube, 2013). One study reveals the influence of positive beliefs of learners (growth mindset) on SFSCS and their learning of SFSCS. Uwerhiavwe (2014) asserts that most learners have the belief that, when interest and determination are present, SFSCS and its learning become easy, enjoyable and interesting.

In this study, I did explore learners' beliefs as a crucial disposition that influences their achievement in SFSCS and its learning. Learners' mindsets, both fixed and growth mindsets, are also products of the learners' beliefs (Dweck, 2013c; Vermeer, 2012a). These mindsets are influenced by the learners' experiences as consequential from the impacts of their learning in the learning process and vice versa (Illeris, 2009). This will be further discussed in the next chapter.

2.6.3 Learners' perceptions about learning

Mindsets are also about perceptions. In a qualitative study, Boaler, William and Zevenbergen (2000) show that, despite being relatively successful in SFSCS and its learning, many learners claimed to dislike SFSCS and its learning - some with real intensity. This is also evident in a learner who has developed a fixed mindset regarding the subject and its learning. Boaler, William and Zevenbergen (2000) attribute the dislike of SFSCS and its learning not only because the routine and practical nature of learning SFSCS prevent the learners access to understand SFSCS, although that was important, but also because of the learners' perceptions toward SFSCS and its learning as being complex, abstract, technical and practical, conflicted with the learners' notions of self and who they intended to become. Most learners related their rejection of SFSCS and its learning based on their beliefs, their personalities and how they perceived themselves in SFSCS and its learning: mindsets, specifically, a fixed mindset. The learners' responses suggest that procedural presentations of SFSCS make SFSCS and its learning less enjoyable, or prevent an understanding of SFSCS for some of the learners. On the contrary, some learners enjoyed SFSCS and its learning, although very few of the learners who liked SFSCS and its learning identified with SFSCS. Their reasons for liking SFSCS and its learning were mainly related to their perceptions of being good at it, or because it would lead to a desired further phase of education or employment: mindsets, specifically, a growth mindset (Boaler, William & Zevenbergen, 2000). To

this end, I explored the aspects of why learners claim to dislike SFSCS and its learning, despite being relatively successful in SFSCS and its learning.

2.6.3.1 Learners' perceptions about making mistakes in learning.

Destin et al. (2019) argue that "learners with more of a fixed mindset tend to avoid challenge and relent when faced with academic difficulty in a learning process, leading to lower academic achievement relative to learners with more of a growth mindset" (p. 2). To this end, Boaler (2013) emphasises that a study shows that making mistakes by a learner is an essential avenue for the learner involved to learn and develop effectively. However, some learners always perceive making mistakes as pointers to their low ability in learning. Notably, a learner's perception of mistakes is a function of the mindset he/she holds regarding mistakes. Mistakes, such as ability grouping, are learning aspects, towards which research and practice are skewed. (Dweck, 2013c; Carey, 2012; Vermeer, 2012a; Bernstein, 1971).

According to Dweck (2012), any time a learner makes a mistake, new synapses [i.e., neurons or gland cells] are developed in his/her brain. As such, any time a learner thinks about why he/she has done something wrongly, new synaptic connections are ignited that make the learner's brain grow. "This scientific fact has profound implications for learning. It suggests that learners should value mistakes and move from viewing them as learning failures to viewing them as learning achievements" (Boaler, 2013, p. 149). The beliefs of learners who hold a fixed mindset have led learners to seek ways to

produce many correct tasks in the classroom. However, if learners are producing voluminous correct tasks, then “their brains are not growing and opportunities for development are missed. Learners need to be working on challenging tasks that result in mistakes; their mistakes should be valued for the opportunities they provide for brain development and learning". To this end, it is great that learners make mistakes which is an essential opportunity for learning. Learners who make mistakes should view mistakes as mistakes and recognise them as "important sites for learning” (Boaler, 2013, p. 149).

2.6.4 Learners’ confidence and competence

The involvement of learners in discursive practices would help them to understand who they are in the learning of SFSCS, as well as the mindsets they hold concerning their intelligence and abilities in the subject and its learning (Noren, 2011). As such, I specifically reviewed studies that involve learners’ confidence and competence in SFSCS and its learning and I related them (confidence and competence) to learners’ mindsets, as mindsets are about confidence and competence.

Learners’ mindsets (fixed and growth mindsets) influence their confidence and, in most circumstances, a learner needs competence to have confidence. A learner’s mindset towards SFSCS and its learning impacts his/her competence in SFSCS and its learning. This, in turn, impacts on the learner’s confidence in SFSCS and its learning: if he/she will be successful or not. Learners who perform confidently are considered competent.

As in most situations plus as earlier mentioned, every learner must be competent to be confident in the study of SFSCS (Darragh, 2013). This is evident in Bishop's (2012) illustration with the interaction between two learners in an SFSCS task, in which one of the learners took the lead in the conversation while the other was listening. It shows that the learner that took the lead was more competent and confident, hence, was able to take the lead. Conceivably, this learner task holds a growth mindset, while the learner who was listening holds a fixed mindset.

Following on the above and in this study, I have, therefore, explored the learners' mindsets that they hold resulting from their confidence and competence in learning SFSCS. Table 4 shows a summary of literature related to learners' confidence and competence in the classroom of SFSCS.

Table 4: Research studies on learners' confidence and competence

S/N	Author(s) and Year of Publication	Research Methodology, Method(s), Participants	Focus of the Study	Findings
1	Pipere and MiEule (2014)	Qualitative research: semi-structured interview with 3 teachers who are also learners.	The dynamics of life-long relationships with SFSCS.	Learners relationship with SFSCS and love of SFSCS as a unique exclusive subject. Different life experiences can lead to different personalities. Interactive patterns emerged resulting from teachers' perception of learners' phobia in SFSCS.
2	Darragh (2013)	Qualitative research: semi structured interview with 6 girls.	Learners' perspectives on their SFSCS learning experiences.	Emergence of two themes: Belonging and Confidence.
3	Bishop (2012)	Qualitative research: interview with interactions between 2 learners.	Interactions between two learners and development of ther personalities.	How the two learners positioned themselves through talk and interaction.

In a qualitative research study, Darragh (2013) found that an influential event in the learners' educational lives was the beginning of high school. Initially, the learners did not have a sense of belonging. They did not feel accepted and comfortable as members of the school community. One of the learners describes the lack of belonging she felt on entry to her first high school SFSCS lesson:

> scared, just knocked on the door. Looked down. Went to a desk. And then, she did not call out my name and I called my name out and then she goes, oh, we all must do a test and then I did the test. The next day when I came to class, she told me to go to [another class], I did not know where to go (Darragh, 2013, p. 221).

This excerpt shows what learning of SFSCS was for that learner at that point in time: SFSCS is scary. The learner does not belong. It is frightening for her to take a test in SFSCS. It further highlights the scariness of the SFSCS lesson for the learner (Darragh, 2013). These are pointers to the mindset the learner holds plus the influence the mindset has on him/her. Note that this learner's experience in SFSCS learning was not different from others in the study. Darragh (2013) argues that in a new arena, learners' narratives in SFSCS learning, suggested they had to demonstrate 'confidence' to be successful at SFSCS and its learning. Drawing on Darragh's assertion, this means that, if the learners do not have a sense of belonging in the SFSCS classroom [school community], this will have a negative influence on their confidence and competence, as well as interest in the study of SFSCS. It is vital to note that knowing people and having friends in the SFSCS classroom are most important in gaining a sense of belonging. In other words, learners who have a strong sense of belonging in their environment are more likely to persist through challenges, as well as be successful in the learning process.

Darragh (2013) concludes that the word ‘confidence’ was used in various ways, bringing to light the diverse meanings and interpretations of the word. The way the learners use the term ‘confidence’ in a specific way: the learners’ understanding of SFSCS. Learners have different perspectives regarding confidence. Some regard it as a lack of fear, the opposite of being shy, or being uncertain and having faith in their abilities. Others link confidence to the behaviour of putting up a hand to answer, asking a question, or sometimes even arguing with their teacher. Others view confidence as evidence of being ‘smart’. In this respect, Graven (2003) notes that a learner who has confidence is not scared to take on new challenges in SFSCS and its learning. He/she believes in his/her ability to rise to new challenges. This is an indication that the learner holds a growth mindset in SFSCS and its learning. Confidence enables one to do what he/she wants to do successfully. Again, this is a pointer to the mindset the learner holds and the influence the mindset has on him/her. A learner’s confidence is a product of both his/her learning and a process of learning. Also, Graven (2003) perceives a learner’s confidence as understanding his/her limitations in SFSCS and its learning. All these are a function of the mindset the learner holds, plus probably judging him/herself as capable or incapable regarding SFSCS and its learning.

Learners who performed confidently were characterised as being competent and apparently smart (Darragh, 2013). Pipere and MiEule (2014) argue that several researchers (Anderson, 2007; Gee, 2000; Wenger, 1998) emphasise the key function of self-recognised and socially acknowledged competence as learners in the learning of

SFSCS. They are learners who display confident behaviour in the SFSCS classroom (Darragh, 2013). In the study, Darragh notes that "if confidence is deemed necessary for successful mathematical learning, then learners who are not comfortable about displaying this confidence exclude themselves right from the start" (Darragh, 2013, p. 225). This is also a function of the mindset the learners hold, more so it influences learners' learning of SFSCS and their achievement in learning. When learners display confidence in the classroom, they would identify themselves as competent, thus developing a more positive, growth learners' mindset. It is worth noting that learners develop mindsets due to their achievement in learning. Hence, some researchers found that learners' academic achievement determines the mindset they develop through their perceived confidence and competence in learning (Zhang, Kuusisto & Tirri, 2017).

There are discrepancies in the studies' approaches to their findings of the reviewed literature on learners' experiences about their confidence and competence in SFSCS and its learning. Pipere and MiEule use learners' different life experiences and relationships to SFSCS and its learning to construct who they are (see Table 2.4). Darragh uses learners' experiences regarding their sense of belonging in the SFSCS classroom as evidence for their confidence and their competence plus smartness. While Bishop uses interactions between two learners in an SFSCS task to show their competence in the subject. It is noteworthy that learners can be given the necessary assistance they need to be confident about the subject and then will perform better at SFSCS and its learning.

Mindsets entail constructed dispositions. My understanding is that while having in-depth knowledge of mindsets as being about beliefs, attitudes, perceptions, confidence and competence, we need to understand that these are not only internal, but are influenced by external relations with other people and in context. Therefore, mindsets are socially influenced and constructed, as opposed to something that is innate, something that is biological, or something that is given in a predetermined way. Put simply, mindsets are social constructions in relation to other people and in context. For a learner to have a positive attitude towards SFSCS and its learning is a consequence of the way he/she is socialised, the kind of background he/she comes from, the amount of support that has been given to him/her [i.e. support given by his/her teachers, peers plus parents (family members)], the experiences he/she has had in the SFSCS classroom and whether he/she has passed or failed examinations (i.e. whether he/she is a high or low achiever in the subject). All these contribute to a positive or negative mindset of the learner. A learner's mindset is not something personal.

2.7 Summary

In this chapter, I started by looking at the concept of learning from a broader sense and some key issues relating to learning have been reviewed. To this end, I conceptualised the definition of learning resulting from the reviewed literature as any transformative process of adding new information that leads to change in learner's qualities, such as mindsets, beliefs, attitudes, perceptions, behaviours and knowledge, or in the capacity to behave in a specific way, which must take place as a result of his/her experience and

interaction with the world. As such, a stand has been taken, from the reviewed literature, on what the concept of learning is in this present study. I discussed learners' attributes and dispositions, as well as how they (attributes and dispositions) influence their (learners) learning.

In addition, I have reviewed literature primarily in relation to SFSCS and reviewed the concept of mindsets. As such, I conceptualise mindsets based on beliefs about the SFSCS and its learning; thereafter, I noted that mindsets are socially influenced and constructed. Learners' emotions and cognition likewise influence their mindsets. This chapter further reviewed literature related to mindsets as well, which illuminates the two distinct types of mindsets people hold and their relationships to learning of SFSCS. The two types of mindsets are fixed mindset and growth mindset. The reviewed literature further illuminates the common and pervasive importance of mindsets, compared the two types of mindsets and deliberated in interventions for changing learners' mindsets.

Ensuing from the reviewed literature, it is crucial to point out that most of the reviewed literature have done little on linking mindsets (fixed and growth mindsets) to strongly framed and strongly classified subjects like mathematics. More so, none of the reviewed literature has explicitly pointed out that the two types of mindsets are not certainly things that are only internal, but things that are also socially influenced and constructed. Furthermore, not much work has linked the three dimensions (cognition, emotional and social) of learning to mindsets in the reviewed literature. These are the gaps this present

study is aiming to fill. Illeris's three dimensions of social learning theory are used to guide this exploration. This is explicitly discussed in the next chapter.

CHAPTER 3

THEORETICAL FRAMEWORK

3.1 Introduction

This chapter discusses the theoretical stance that underpins and informs this study. I draw on social learning theory (SLT) as a theoretical lens to explore the influence of mindsets in the learning of n SFSCS such as mathematics Specifically, I use three dimensions of Illeris's Social Learning Theory (ISLT): the cognitive, emotional and social dimensions, to frame the study. Within this frame, I link it to Bernstein's notion of a strongly framed and strongly classified subject (SFSCS) and Dweck's mindsets theories (MSTs) - that is, Dweck's distinction of the fixed mindset and growth mindset. Together, these enable me to understand the influence of mindset within the cognitive, emotional and social frame of a learner in the learning of an SFSCS. I begin this chapter with a brief discussion of some social learning theories (SLTs), I then provide a justification for the suitability of Illeris's social learning theory (ISLT) for this study. This is followed by a detailed discussion of Illeris's three dimensions of learning and how they are framed in this study. Finally, I conceptualise a model to show the key concepts in this present study.

3.2 Social learning theory (SLT)

Learning theories aim at describing the frameworks that are used in processing and retaining knowledge. That is, how learners absorb, process and retain knowledge during the learning process. There are various types of learning theories (LTs) that help to explain how we learn, each of which highlights different aspects of learning and each is useful for different purposes as well. Among the various types of LTs are behaviourist LT, cognitive LT, constructivist LT, connectivism LT, situated LT, experiential LT, adult LT and social LT (Strauch & Alomar, 2014; Ertmer & Newby, 2013; Schunk, 2012; Crain, 2011).

In spite of the fact there are various types of LTs, there are three schemas of LTs that they all fall under: (a) Behaviourism, which is premised on the notion that knowledge is independent and it is external to the learner (i.e. via interactions). Learning and behaviour changes are acquired on the basis of linking stimuli and response, cognitivism and constructivism. To this end, behaviourism assumes that the learner is passive and only responds to external stimuli, like reward and punishment (Strauch & Alomar, 2014; Ertmer & Newby, 2013; Schunk, 2012), (b) Cognitivism, which is contrary to behaviourism, as it is premised on the notion that learners process information as they receive the information, instead of just responding to stimuli like behaviourism. In other words, cognitivism emphasises an exploration of mental processes like thinking, memory, knowing and problem-solving. That is, learning is internal, because of new information that is processed and organised - cognitivism

argues that one's learning is a function of the internal processes, instead of external stimuli (Strauch & Alomar, 2014; Ertmer & Newby, 2013; Schunk, 2012; Crain, 2011), (c) Constructivism, which is a social process embedded in social relations. Constructivism is something that is constructed by human beings in relation to others and in context. Simply put, constructivism means constructing things with other people and in context. It is human construction that is not innate, something biological, or something given to anyone in a predetermined way. Constructivism is about social constructions in relation to other people and in context. It proposes that learning is an active process whereby one creates his/her subjective reality representation. This is the knowledge that is developed through adapting new information on the basis of prior knowledge, plus the learner's experiences with his/her environment (Stevens-Fulbrook, 2019; Mind-Tools, 2018; Strauch & Alomar, 2014; Ertmer & Newby, 2013; Schunk, 2012; Crain, 2011).

Following the above, this present study is located within the social learning theory as it covers the three schemas of LTs mentioned earlier: behaviourism, cognitivism and constructivism. A social learning theory (SLT) is found suitable in this study because it takes social interactions into consideration. A learner can learn from anybody like his/her teachers, parents and peers. SLT stresses interpersonal relations that include imitation and modelling (transmission), experience, perception, activity and participation – and consequently "focus on the study of cognitive processes by which observation can become a source of learning. Furthermore, it is useful for understanding

the detailed information-processing mechanisms by which emotions and social interactions affect behaviour". SLT is pertinent to the actions we take every day plus our policies, as well as the technical, organisational and educational systems we design (Badyal & Singh, 2017; Strauch & Alomar, 2014; Wenger, 2009, p. 216; Illeris, 2007).

Furthermore, there are various social learning theories that are used in education. Among them are Akers' social learning theory (ASLT), Bandura's social learning theory (BSLT), Wenger's social learning theory (WSLT) and Illeris's social learning theory (ISLT). The key focuses of these SLTs are noted below.

ASLT fundamentally focuses on crime and criminality. ASLT emphasises that people learn new attitudes, behaviours and skills to commit crimes through direct experience and observing the beharious of other people with whom they associate and interact (Cochran, Maskaly, Jones & Sellers, 2015; Akers, 2009; Akers, 1998). BSLT primarily incorporates the idea of reinforcement of a learner's behaviour from the former, as well as cognitive processes, such as memory, attention and motivation, from the latter. While BSLT underscores three general principles for learning: observational learning, imitation and modelling, through Bandura's famous "bobo doll" experiment, where he argues that everyone learns through observation, imitation and modelling (Cherry, 2019; Wheeler, 2017; McLeod, 2016; Nabavi, 2012; Crain, 2011; Bandura, 1999; Bandura, 1977).

Regarding WSLT, learning is fundamental to human identity. Wenger basically argues that learning is not only an individual pursuit but a social one as well (Wenger, 2009; Wenger, 1998). Everyone is a social being who learns through social interaction. WSLT stresses what matters about learning and regarding the nature of knowledge and knowing, as well as knowers. Wenger's assumptions regarding what matters concerning learning and the nature of knowledge, knowing and knowers are summarised, thus, human beings are social beings, which is the fundamental aspect of learning. For knowledge, it is a matter of competence regarding valued enterprises, as well as a matter of participating in the quest of such enterprises. That is, of active engagement in the world. Concerning meaning, it is the ability of learners to experience the world and for them to engage with it meaningfully. It is ultimately what learning is to produce. The central focus of WSLT is learning as social participation. He conceptualises participation as "not just to local events of engagement in certain activities with certain people, but to a more encompassing process of being active participants in the practices of social communities and constructing identities in relation to these communities". Furthermore, participating in a group activity is an action plus a belonging. Such participation does not only influence what the learners do, but who the learners are and how they translate what they do as well. Learning by participating in social groups has been referred to as "Communities of Practice (CoP)" (Li, Grimshaw, Nielsen, Judd, Coyte & Graham, 2009; Wenger, 2009, pp. 210 & 212; Wenger, 1998, p. 4; Jean & Wenger, 1991).

For ISLT, the theory is premised solely on the three learning processes, which are basically classified into the external and internal learning processes. SLT encompasses the learning field entirely: (i) external learning process - the external interaction process between learners and their social plus cultural or material environment; this is the social process and (ii) internal learning process - the internal psychological processes of acquisition and elaboration; this is the cognitive and the emotional processes. Illeris highlights that learning takes place on different levels, which are influenced by social context and support of the environment kind of practice that impact it (Illeris, 2009; Illeris, 2003).

Several learning theories dwell on only one of the learning processes. This does not imply that they are not correct or useful since both can be differently studied; though, it implies that they do not embrace the learning field entirely. The concept of learning needs to be understood in a comprehensive sense; therefore, there is a need to revise traditional learning theories. It must be emphasised that the "genuine learning theory is about how learning takes place and functions in various situations; not about how it can be streamlined as an industrial production process - simply because learning is entirely human and in no way industrial matter" (Illeris 2015, p. 39). From this perspective, ISLT is a comprehensive learning theory. Therefore, ISLT is selected for this study because it embraces the learning field entirely - ISLT is presented based on the fundamental assumptions that learning involves the three different processes which are classified into two unique processes, such as (a) acquisition process, i.e. the internal

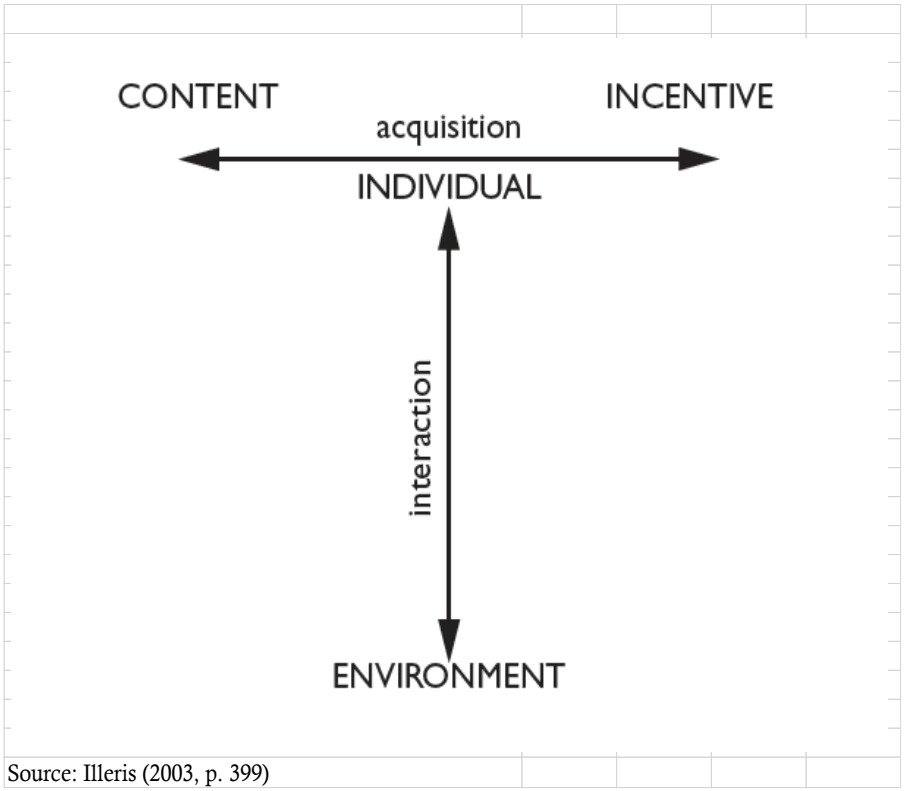
psychological process of acquisition and elaboration of the acquisition [such as the cognitive and emotional] – which occurs inside the learner and (b) interaction between the individual (learner) and his/her environment, i.e. the external interaction process between a learner and his/her social plus cultural or material environment [such as the social] – which occurs outside the learner.

As indicated previously, the two unique processes – external and internal learning processes – combined to form the three dimensions of social learning. These are (i) the content dimension (understanding, knowledge and skills) and the incentive dimension (motivation, emotion and volition). These two dimensions have to do with the individual acquisition process. and (ii) the social and society dimension This dimension has to do with acquisition through interactions (action, communication and cooperation): the interaction process between the individual (learner) and his/her environment. It is worth noting that, without the consideration of the three dimensions of social learning, no learning process can be understood completely (Illeris, 2015; Strauch & Alomar, 2014; Illeris, 2009, 2007, 2003 & 2002).

3.3 Illeris's dimensions of social learning

Illeris (2015) asserts that every learning comprises the three dimensions of social learning: the cognitive (content), the emotional (incentive) and the social (interaction). It is a fundamental understanding that the cognitive and the emotional of the acquisition process always function in an integrated and inseparable way. Illeris (2015) further

asserts that "no process of learning can be fully understood without considering all the three dimensions" (p. 1).

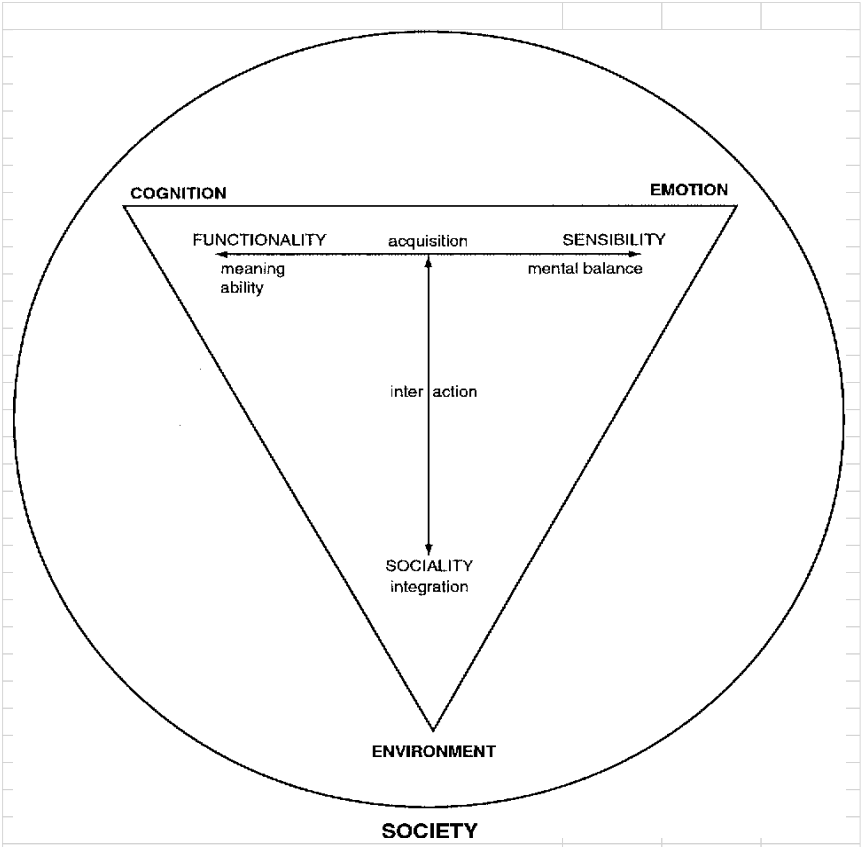


Source: Illeris (2003, p. 399)

Figure 2: The fundamental processes of learning

Illeris (2003) extends the model in Figure 2. This is shown in Figure 3 (the processes and dimensions of learning), where the two dual-headed arrows are now placed in a triangular field between the three angles. The arrow (vertical dual-headed arrow), the external interaction process, is "between the environment, which is the general basis and therefore, placed at the bottom. The individual is the specific learner and, therefore, placed at the top (Figure 2)". The other arrow (horizontal dual-headed arrow) is placed

between cognition and emotional. The cognition deals with the content of learning, while the emotional provides the necessary mental energy of the process (p. 398).



Source: Illeris (2003, p. 400)

Figure 3: The processes and dimensions of learning

The three angles represent three dimensions: cognitive dimension, emotional or psycho-dynamic dimension and social dimension. This is the fundamental claim of the theory that every learning will always encompass these three dimensions of social learning (Illeris, 2015; Illeris, 2003; Illeris, 2002). The three dimensions and how they are applied in my study are discussed briefly below.

3.3.1 Cognitive dimension

The cognitive dimension relates to the learning content. For this present study, it is about the learning content of SFSCS, so the cognitive dimension is about what a learner learns. It is referred to as the knowledge that develops a learner's understanding and ability. That is the knowledge and understanding of oneself: one's strengths and weaknesses (Illeris, 2015; Illeris, 2009; Illeris, 2002). This implies that the cognitive dimension [i.e. the learning content] subjectively influences the learners' own mindsets. More so, the cognitive dimension is "always subjectively influenced by the learners and the individual emotional and motivational value ascribed to it and that the emotional and motivational engagement is always influenced by the learning content" (Illeris, 2015, pp. 8 - 9). The learning content (cognitive) may trigger the learners' emotions positively or negatively with/without the enthusiasm and persistence to learn, as some learners sometimes feel determined/frustrated, excited/boredom and courageous/anxious during learning. All these influence the learners' mindsets as the positive emotions relate to the learners' growth mindset, while the negative emotions relate to the learners' fixed mindset.

Within this dimension, the learner attempts to construct meaning and ability to handle real-life challenges, consequently building a general personal functionality. Knowledge, skills, understanding and attitudes are crucial aspects of the learning content and are always referred to in this dimension (Illeris, 2015; Illeris, 2007; Illeris, 2003). The cognitive dimension implications of SFSCS are that they push learners to learn about

learning manners and push teachers cognitively to only teach directly to the content that is needed, as they (teachers) cannot go beyond the content in order to teach it.

The things a learner learns (knowledge, understanding and attitudes) influence his/her mindset, particularly in the context of learning of SFSCS. To this end, it is evident that the cognitive dimension of social learning is related to the learners' mindsets (fixed and growth mindsets), as it influences the mindsets they construct, and vice versa in the learning process.

In line with the discussion of the cognitive dimension above, within the dimension and under the category mindsets, I infer distinct critical descriptors of each of the sub-categories (fixed mindset and growth mindset) with the summary of the descriptors in the figure (Figure 4). This enhances the easy identification of the indicators of the cognitive dimension in the subsequent chapters of this present study.

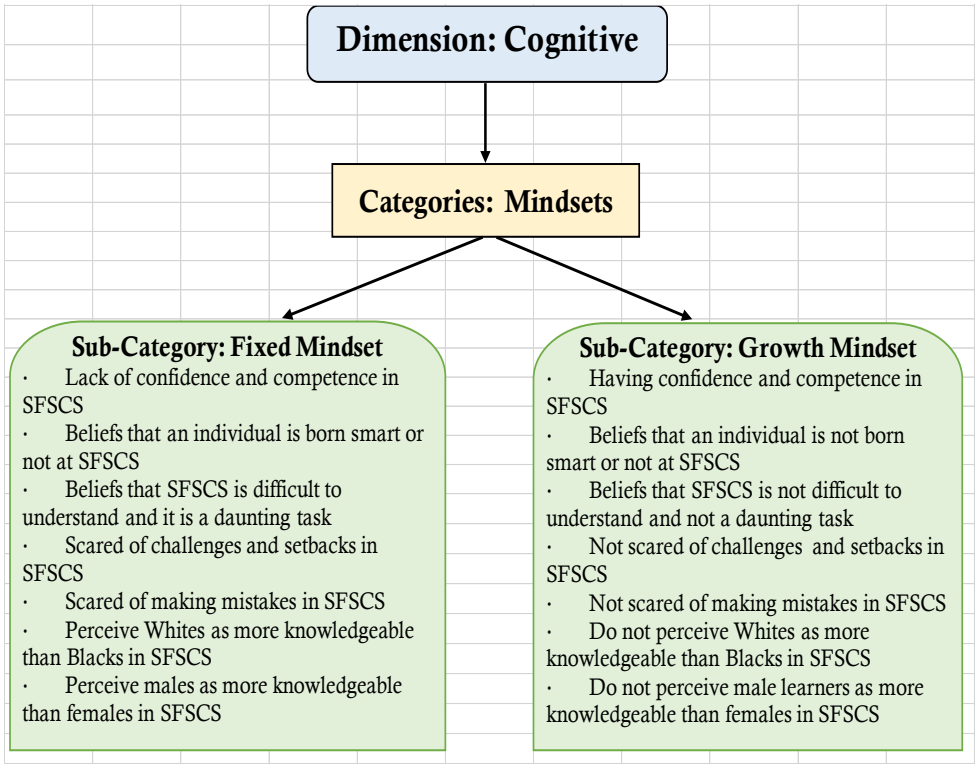


Figure 4: Categorisation of the cognitive dimension and related constructs

In Figure 4, I highlight the two categories provided. Below are brief discussions of the descriptors that are presented under the sub-categories (fixed and growth mindsets).

3.3.1.1 Lack of and having confidence and competence in SFSCS

This sub-category focuses on mindsets regarding confidence and competence in SFSCS and its learning. Some people have a negative attitude of not being confident and competent in SFSCS and its learning. Such people are anxious about SFSCS learning. This relates to people who have constructed a fixed mindset. On the other hand, some people have a positive attitude of being confident and competent in SFSCS and its

learning. Those who have confidence and competence are not scared or anxious to take on new challenges in SFSCS and its learning; they believe in their intelligence and abilities to rise to new challenges. This relates to people who have constructed a growth mindset (Zhang, Kuusisto & Tirri, 2017; Graven, 2003; Dweck, 2000). These mindsets (fixed and growth mindsets) about confidence and competence are linked to both the cognitive dimension and emotional dimension and they are constructed socially in relation.

3.3.1.2 Beliefs that an individual is born smart or not at SFSCS

This sub-category emphasises mindsets regarding smartness at SFSCS and its learning. Some people believe that an individual is born smart or not to effectively learn SFSCS and nothing can be done about it. This speaks to people who have developed a fixed mindset. On the contrary, some people believe that an individual is not born smart or not to effectively learn SFSCS. Being smart at SFSCS is achieved through effort (i.e. smartness can be learned). This speaks to people who have developed a growth mindset (Haimovitz & Dweck, 2017; Boaler, 2016 & 2013; Yeager & Dweck, 2012; Blackwell, Trzesniewski & Dweck, 2007; Dweck, 2006a & 2006b). These fixed mindset and growth mindset about beliefs are related to both cognitive dimension and emotional dimension and they are constructed socially in relation.

3.3.1.3 Beliefs concerning the understanding of SFSCS

This sub-category stresses mindsets about the understanding of SFSCS in the learning process. Some people believe that SFSCS are a naturally difficult, complex and daunting a task to understand. Furthermore, it is for those that are gifted and talented. This links to people who hold a fixed mindset. Contrarily, some people believe that SFSCS are not difficult, not complex and not a daunting task to understand. More so, no one is gifted and talented to understand SFSCS. This links to people who hold a growth mindset (Gholson & Martin, 2019; Ali, Bhagawati & Sarmah, 2014; Uwerhiavwe, 2014; Tshabalala & Ncube, 2013; Maliki, Ngban & Ibu, 2009). These fixed and growth mindsets about people's beliefs are connected to both cognitive and emotional dimensions and they are constructed socially in relation as well.

3.3.1.4 Challenges and setbacks in SFSCS

This sub-category aims at mindsets toward challenges and setbacks in SFSCS and its learning. Learners react to challenges and setbacks differently in the learning process of SFSCS. Some people believe that some learners are scared of challenges (challenging tasks) and setbacks in the learning of SFSCS, as learners are scared of failure. This relates to people who have constructed a fixed mindset. In contrast, some people believe that some learners are not scared of challenges (challenging tasks) and setbacks in SFSCS and its learning. Learners are not scared of failure, as they embrace challenges and setbacks. This relates to people who have constructed a growth mindset (Destin et al., 2019; Bernecker & Job, 2019; Rissanen, et al., 2019; Tirri & Kujala, 2016; Boaler,

2016 & 2013; Yeager & Dweck, 2012; Blackwell, Trzesniewski & Dweck, 2007). These mindsets (fixed mindset and growth mindset) about learners' challenges and setbacks are connected to both cognitive and emotional dimensions and they are constructed socially in relation.

3.3.1.5 Mistakes in SFSCS

This sub-category underscores mindsets about mistakes in SFSCS and its learning. Some people believe that learners are scared of making mistakes in SFSCS. Learners view mistakes as a lack of intelligence plus abilities and give up [on a task] in SFSCS and its learning. This connects to people who have developed a fixed mindset. Contrarily, some people believe that some learners are not scared of making mistakes in SFSCS. They (learners) do not view mistakes as a lack of intelligence or ability and do not give up, they persist [on a task] in SFSCS and its learning. This connects to people who have developed a growth mindset (Cherry, 2020; Rissanen et al., 2019; Sun, 2018; Haimovitz & Dweck, 2017; Boaler, 2013; Dweck, 2013c). Both fixed and growth mindsets about learners' making mistakes are associated with both cognitive and emotional dimensions and they are constructed socially in relation.

3.3.1.6 Perceptions concerning knowledge in terms of race in SFSCS

This sub-category focuses on mindsets concerning knowledge in terms of race in SFSCS learning. Some people perceive that White learners are more knowledgeable (smarter) than Black learners in SFSCS and its learning. They believe that being smart

at SFSCS is a function of one's race. This relates to people who have constructed a fixed mindset. Conversely, some people do not perceive that White learners are more knowledgeable (smarter) than Black learners in SFSCS and its learning. They believe that having good knowledge of SFSCS is not a function of one's race. This relates to people who have constructed a growth mindset (Martin, 2012; Lubienski, 2002). These fixed mindset and growth mindsets about people's perceptions are linked to both cognitive and emotional dimensions and they are constructed socially in relation.

3.3.1.7 Perceptions concerning knowledge in terms of gender in SFSCS

This sub-category stresses mindsets regarding knowledge in terms of gender in SFSCS. Some people perceive that male learners are more knowledgeable (smarter) than female learners in SFSCS and its learning. They believe that being smart at SFSCS is a function of one's gender. This relates to people who have developed a fixed mindset. Conversely, some people do not perceive that male learners are more knowledgeable (smarter) than female learners in SFSCS and its learning. They believe that having good knowledge of SFSCS in learning is not a function of one's gender. This relates to people who have developed a growth mindset (Radovic, Black, Salas & Williams, 2017; Ali, Bhagawati & Sarmah, 2014; Maliki, Ngban & Ibu, 2009; September, 2005; Ontario Ministry of Education, 2004). These mindsets (fixed mindset and growth mindset) about people's perceptions are associated with both cognitive and emotional dimensions and they are constructed socially in relation as well.

3.3.2 Emotional dimension

The emotional dimension entails mental energy (volition), feelings (emotions) and motivations (Illeris, 2009; Illeris, 2003). For this present study, it is about the volition, feelings and motivation in the learning of SFSCS. In this sense, this dimension could be referred to as the incentive dimension of learning. More so, the content of learning is a function of the energy produced by the incentive dimension, which fuels the energy and motivates a learner for the acquisition of learning content, while interesting and pertinent learning content motivates him/her in learning. The main function of this dimension is for the learner to attain mental balance and simultaneously build a personal sensibility (Illeris, 2015; Illeris, 2009; Illeris, 2007; Illeris, 2003; Illeris, 2002). The emotional dimension implications of SFSCS are that, emotionally, there is so little choice, which makes the teachers and learners feel more helpless.

It is equally evident that this dimension of social learning is connected to learners' mindsets (fixed and growth mindsets), as they do influence the volition, feelings and motivations of the learner's self-perception about SFSCS and vice versa in the learning process. The learners' emotions have a positive or negative impact on themselves in SFSCS and its learning, such that the learners will/with not be motivated, or have the desire, or feel interested to learn in the learning process. All these influence the learners' mindsets, either positively or negatively. The positive emotions relate to the learners' growth mindset, while the negative emotions relate to the learners' fixed mindset - these

are equally influenced by the cognitive aspect as well, which is constructed socially in relation.

Illeris (2003) highlights that the two dimensions (cognitive and emotional or psycho-dynamic) are "constantly introduced by impulses from the interaction processes and integrated into the internal process of acquisition and elaboration" (p. 399). Consequently, every cognitive learning is "obsessed by the emotions at stake, (e.g. whether the learning is driven by desire, interest, necessity or compulsion". Similarly, emotional learning is constantly influenced by cognition [or understanding], e.g., new information can change the emotional condition" (Illeris, 2009; Illeris, 2003, p. 399, Illeris, 2002). This means that both the cognitive dimension and the emotional dimension are interrelated and are influenced internally. Due to this dimension, learners' volition and interest to study SFSCS are influenced by the learners' mindsets (fixed and growth mindsets) and vice versa in the learning process.

In line with the discussion of the emotional or psycho-dynamic dimension, within the dimension and under the category mindsets, I infer distinct critical descriptors of each of the sub-categories (fixed mindset and growth mindset) with the summary of the descriptors in the figure (Figure 5). This enhances the easy identification of the indicators of the emotional or psycho-dynamic dimension in the subsequent chapters of this present study.

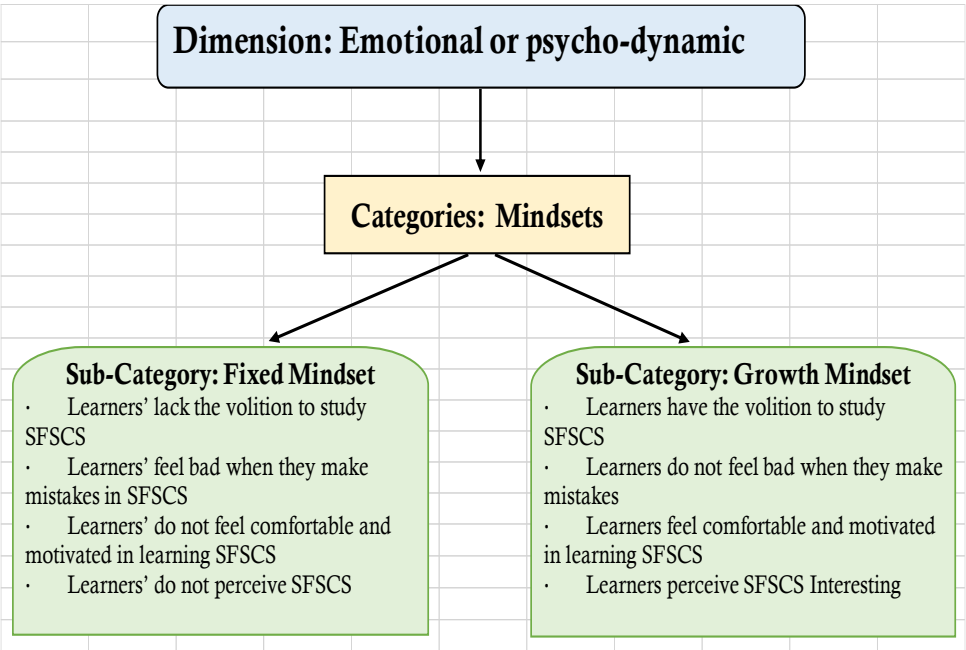


Figure 5: Categorisation of the emotional or psycho-dynamic dimension and related constructs

In Figure 5, I describe the two categories provided. The following are brief expositions of the descriptors that are presented under the sub-categories (fixed and growth mindsets).

3.3.2.1 Lack of volition to learn SFSCS

This sub-category focuses on mindsets regarding lack of desire or motivation to learn SFSCS. Some people believe that some learners lack the desire or are not motivated to learn SFSCS and embrace mistakes and setbacks in the learning process. They dislike SFSCS and its learning, only learning them because it is compulsory. These are a pointer to a fixed mindset the learners have constructed. On the other hand, some people

believe that some learners have the drive (desire) or are motivated to learn SFSCS and embrace mistakes and setbacks in the learning process. They like SFSCS and its learning. The learners are learning SFSCS not just because it is compulsory for them, but because it is fun, interesting and enjoyable. These are a pointer to a growth mindset the learners have constructed (Cherry, 2020; Appell, 2019; Rissanen et al., 2019; Sun, 2018; Haimovitz & Dweck, 2017; Popova, 2014; Boaler, 2013; Boaler, William & Zevenbergen, 2000). These mindsets (fixed mindset and growth mindset) about people's volition are linked to both emotional and cognitive dimensions and they are constructed socially in relation.

3.3.2.2 Feelings when mistakes are done in SFSCS

This sub-category emphasises mindsets about learners' feelings when they make mistakes in SFSCS. Some people believe that some learners feel sad whenever they make mistakes in solving a problem in SFSCS. As such, they do not persist in the task to get the answer correctly. These are a pointer to a fixed mindset that the learners hold. Conversely, some people believe that some learners do not feel sad whenever they make mistakes in solving a problem in SFSCS. As such, they persist in the task to ensure they get the answer correctly. These are a pointer to a growth mindset that the learners hold (Campbell, Craig & Collier-Reed, 2019; Zhang, Kuusisto & Tirri, 2017, p. 1369; Claro, Paunesku & Dweck, 2016). These fixed mindset and growth mindsets about people's feelings when they make mistakes are connected to both emotional and cognitive dimensions, which are constructed socially in relation.

3.3.2.3 Feeling comfortable and motivated in SFSCS

This sub-category focuses on mindsets about learners' feelings of being comfortable or not, as well as motivated or not in the learning of SFSCS. Some learners do not feel comfortable and determined in SFSCS learning as they believe it is not fun or easy to understand and that some learners are gifted with the knowledge of SFSCS. These are a pointer to a fixed mindset that the learners have developed. On the contrary, some learners feel comfortable and determined in SFSCS learning, as they believe it is fun and easy to understand and that no learner is gifted with the knowledge of SCSFS. These are a pointer to a growth mindset that the learners have developed (Zhang, Kuusisto & Tirri, 2017; Boaler, 2016 & 2013; Uwerhiavwe, 2014; Darragh, 2013; Dweck, 2013b, 2006a & 2006b; Obomanu & Adaramola, 2011; Mercer & Ryan, 2010). Mindsets about people feeling comfortable or not and motivated or not are connected to both emotional and cognitive dimensions, which are constructed socially in relation.

3.3.2.4 Perceptions toward interest in SFSCS

This sub-category highlights mindsets about perceptions regarding learners' interest in SFSCS and its learning. Some people perceive that SFSCS learning is not interesting, rather, it is a complex, daunting and confusing task. These are a pointer to a fixed mindset that the learners hold. In contrast, some people perceive that SFSCS is interesting and not confusing, as well as not being a complex and daunting task. These are a pointer to a growth mindset that the learners hold (Uwerhiavwe, 2014; Boaler, 2013; Tshabalala & Ncube, 2013; Obomanu & Adaramola, 2011; Maliki, Ngban & Ibu,

2009). These fixed and growth mindsets about people's perceptions are associated with both emotional and cognitive dimensions, which are constructed socially in relation.

3.3.3 Social dimension

Social dimension (social and societal) is concerned with the interaction process, since there are always other people who are involved, directly or indirectly and it is connected to society. For this present study, it is about the interactions that are evolving in the learning of SFSCS. This is external interaction, such as participation, communication and cooperation. This provides a learner's integration into communities and society. Consequently, the learner's sociability is developed. In a process where a learner integrates his/herself in a community (society), he/she interacts with the community (Illeris, 2015; Illeris, 2009; Illeris, 2007). These interactions have an impact on the mindset he/she holds. Therefore, it is evident that this dimension is linked to other people's mindsets (fixed mindset and growth mindset).

As discussed in Chapter 2, other people's mindsets are the mindsets of the learners' teachers, parents and peers concerning their learning of SFSCS in the learning process. It is crucial to note that the environment (society), teachers', parents' and peers' perspectives about the learners influence the learners' mindsets about SFSCS and vice versa, during interactions (participation, communication and cooperation) in the learning process. This indicates that the cognitive dimension, emotional dimension and social dimension are always connected with each other. More so, other people's

mindsets influence learners' mindsets. To this end, the social dimension is linked to the mindsets (fixed mindset and growth mindset) that other people hold about learners' attributes and dispositions in SFSCS and its learning, in this present study as other people's mindsets have an impact on learners' mindsets during interaction processes. It crucial to say that learning reflects the social and societal situations according to which a learner will be able to interact. The form of interaction spans from its simplest to more engaged forms: participation, perception, communication, experience, activity and imitation (Illeris, 2015; Illeris, 2009; Illeris, 2007; Illeris, 2003; Illeris, 2002). The social dimension implications of SFSCS are that it is restricted in terms of content that can be covered and limited in terms of the amount of participation that will be given to the teachers and learners. It means that one will not be able to influence a lot of what happens in terms of SFSCS through more social interactions. Social interactions will help. As such, there is a necessity to weaken the frame of SFSCS in order to get people to participate more in SFSCS and its learning.

Illeris (2003) further highlights that the learning triangle in Figure 3 depicts "the tension field of learning plus any specific process of learning as stretched out between the building up of functionality, sensibility and sociality" (p. 400). The social dimension of learning depicts that learning cannot take place in a vacuum; rather, learning always takes place in an existing social and societal context. This sets the rudimentary situations for learning to be possible. The triangle inside the circle [which represents the social and societal] indicates the rudimentary situation. A learning situation is seen as

space whereby learning occurs. This will influence the outcomes of learning all the time. To this end, "every learning is regarded as 'situated learning'; simultaneously, learning in one learning space is both influenced by and influences, learning in the other spaces in which the learner in question is involved" (Illeris, 2015; Illeris, 2009; Illeris, 2003; Illeris, 2002, p. 201).

In line with the discussion of the social dimension above, within the dimension and under the category mindsets, I infer distinct critical descriptors of each of the sub-categories fixed mindset and growth mindset with the summary of the descriptors in the figure (Figure 6). This enhances the easy identification of the indicators of the social dimension in the subsequent chapters of this present study.

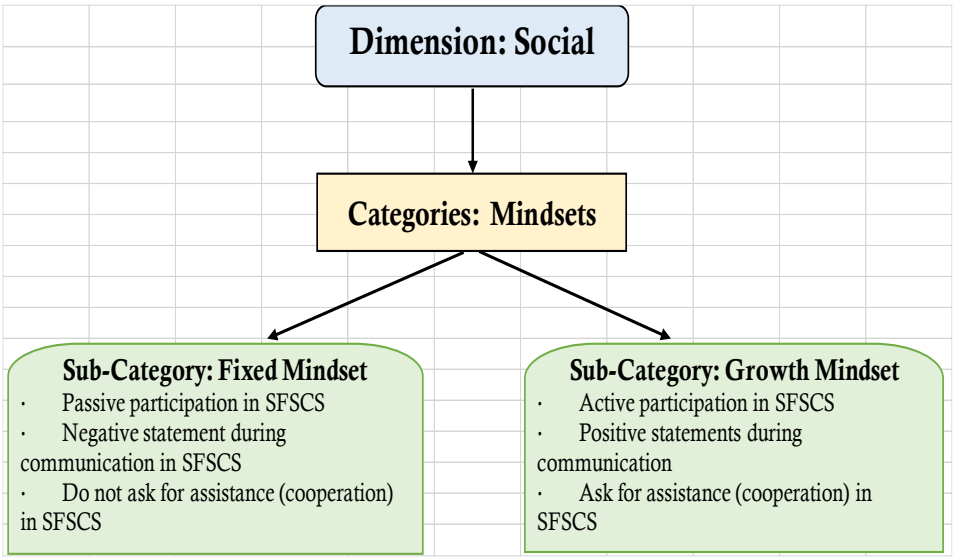


Figure 6: Categorisation of the social dimension and related constructs

In Figure 6, I underscore the two categories provided. Below is a brief discussion of the descriptors that are presented under the sub-categories (fixed and growth mindsets).

3.3.3.1 Participation in SFSCS

This sub-category emphasises people's mindsets concerning the learners' interactions – involvements in terms of what the learners do (actions) in SFSCS and its learning. Some people believe that some learners learn passively or do not participate in SFSCS in the learning process. People view these qualities as innate and cannot be changed. As such, some people believe that learners are not born smart and lack the ability to learn SFSCS effectively. They relate these qualities to learners' attributes (like race and gender). These are functions of a fixed mindset that they have constructed. On the other hand, some people believe that some learners actively participate in SFSCS and its learning. They (people) do not view these qualities as innate but can be grown. As such, they do not believe that learners are neither born smart or not to learn SFSCS effectively. They do not relate smartness or not to learners' attributes (like race and gender). These are functions of a growth mindset that they have constructed (Zion & Crum, 2018; Radovic, Black, Salas & Williams, 2017; Zhang, Kuusisto & Tirri, 2017; Martin, 2006; Ontario Ministry of Education, 2004). These mindsets (fixed mindset and growth mindset) about people's perceptions of learners' interactions (i.e. participation) in SFSCS and its learning are linked to the social dimension.

3.3.3.2 Statements during communication in SFSCS

This sub-category highlights people's mindsets regarding learners' interactions with others in terms of what the learners say in SFSCS and its learning. Some people believe that some learners are not confident and competent plus not motivated to learn SFSCS in the classroom and at home. Learners make statements that depict these perceptions, such as SFSCS is not my path, SFSCS is a difficult, tricky and complex subject. As such, they do not enjoy it and find it interesting. Some people perceive these qualities as innate and cannot be changed - this perception indicates they hold a fixed mindset. On the contrary, some people believe that some learners are motivated to learn SFSCS in the classroom and at home and learners can be confident and competent if they desire to. Learners make statements that depict these perceptions, such as SFSCS is my path, SFSCS is not a difficult, tricky and complex subject and I always do well in it. As such, they (learners) enjoy it (SFSCS) and find it interesting. Some people do not perceive these qualities as innate but achievable - this perception indicates they hold a growth mindset (Radovic, Black, Salas and Williams, 2017; Vandewalle, 2012; Dweck, Chiu & Hong, 1995). These fixed mindset and growth mindset about people's statements on learners' interactions (i.e., communication) in a SFSCS learning process are linked to the social dimension.

3.3.3.3 Assistance (cooperation) in SFSCS

This sub-category focuses on people's mindsets regarding learners' interactions when they are doing SFSCS group work or activities in the learning process. Some learners do

not participate or feel reluctant to do their tasks (assignments – group work, classwork and homework). As such, some people perceive that the learners lack the intelligence and abilities to do their tasks. Also, some learners do not seek assistance when they are stuck, instead they feel sad and give up. They do not ask for support from others. These indicate that they have developed a fixed mindset. Conversely, some learners participate or do their tasks (assignments, group work, classwork and homework) when due. More so, some people perceive that the learners have the desire, motivation and interest to do their tasks. Such learners seek assistance when they are stuck. They do not feel sad, instead they persist. These indicate a growth mindset (Rissanen et al., 2019; Zion & Crum, 2018; Haimovitz & Dweck, 2017; Boaler, 2013; Lubienski, 2002; Swanson, 2002). These fixed and growth mindsets about assistance people render to learners during interactions in an SFSCS learning process are associated with the social dimension.

3.3.4 Synthesis of the three dimensions of learning

With the sighting of an instance using a learner experience in the classroom, Illeris (2009 & 2003) emphasises that acquisition is not just a cognitive matter. There is another mental function that is involved with respect to a learner's attitude to the intended learning, such as the learner's interest plus mobilisation of mental energy - this is a function of the emotional or psycho-dynamic dimension. In a school (classroom) "situation focus is usually on the learning content". Yet, the emotional function is likewise crucial, i.e. how the situation is experienced, the kind of feelings and

motivations that are involved and, consequently, the nature plus the strength of the mental energy that is involved. The "value and durability of the learning outcomes are closely related to the emotional dimension of the learning process". Additionally, the interplay between the cognitive function and the emotional function is dependent on the process of interaction between the learners and the social, cultural and material environment in the learning process (Illeris, 2009; Illeris, 2003, p. 401; Illeris, 2002).

I will reiterate that Illeris (2009 & 2003) posits that in the model (Figure 3) is a learning concept which is essentially constructivist. It is the assumption that the learner actively develops or perceives his/her learning as mentally, emotionally and socially constructed. In every situation, “it is crucial that learning outcomes are designed before they can be retained” (Illeris, 2003, p. 401). In this regard, Illeris (2015) highlights that “the most important single factor influencing learning is what the learner already knows” (p. 3). He further highlights that one of the main areas of the theory is the barriers of learning or the thing that happens when intended learning is understood in an inadequate or distorted manner, or completely not understood (Illeris, 2009 & 2007). In this area, there are three groups that are primarily related to each of the learning dimensions, to combine with a strong propensity: (a) Mislearning is associated with the content dimension and involves misunderstanding, lack of concentration and pertinent conditions or prior learning, as well as unclear communication (b) Learning defence is connected to the incentive dimension and consists of learning that is rejected, distorted, obstructed, hindered, or derailed due to "defence mechanisms or conflicting learning,

due to ambivalence (a defence) or the like" (McLeod, 2019, para. 1; Illeris, 2015, p. 3; Illeris, 2009; Illeris, 2007) (c) Learning resistance is linked to the interaction dimension and contains unwanted learning or conflicting learning with a learner's values, preferences and understandings. Mislearning, learning defence and learning resistance constrain learning and are associated with a fixed mindset, because they have negative consequences for learning. Illeris (2007) asserts that there is a difference between defence against learning and resistance to learning. The difference is that "a defence against learning is preparedness that is at one's disposal, whereas resistance is something that is mobilized in certain situations where the individual is faced with something that he or she cannot or will not accept" (p. 170).

Based on Illeris's notion that the critical factor that influences learning is the learner's prior knowledge, the things a learner already knows were influenced by his/her own mindset, because that mindset influences his/her learning and vice versa. This is a pointer to the notion that the mindsets learners hold concerning intelligence and abilities influence their learning and academic achievements in the learning process. More so, the mislearning, learning defence and learning resistance that are basically related to each of the learning dimensions (content dimension, incentive dimension and social dimension) respectively are equally influenced by mindsets about learning.

Illeris (2015) further emphasises that the theory (ISLT) entails several other areas. The crucial areas are (i) The learners' qualities plus preconditions. Preconditions to learning include heredity, dispositions, environment, intelligence, abilities, race, gender and

learning styles (ii) Learning at different life stages or ages, which includes the characteristics and differences between learning from childhood to mature adulthood, (iii) The influence of different kinds of learning spaces, including everyday learning, educational learning, workplace learning, net-based learning, interest-based learning, and grassroots activities and transversal learning" and (iv) the influence of the general conditions of the society on learning (Illeris, 2015, pp. 3 & 10; Illeris, 2007).

With this in mind, it is central to reiterate that the present study focuses on ISLT, as it is about learners 'situation specificity' behaviour. ISLT suggests that learners' behaviours are not solely a function of learners' own qualities, but also of their environment. "Behaviour is, therefore 'specific' to a particular situation". In this sense, one should expect a learner to behave differently in different situations (Illeris, 2002, p 125).

Given the above and drawing on the three dimensions of ISLT (2015, 2009, 2007, 2003 & 2002), it implies that SFSCS learning takes place when the cognitive level is formulaic and abstract [i.e., strongly framed]. This is influenced by the learners' mindsets. For the emotional or psychodynamic level, learners' mindsets are about attitudes, beliefs, confidence and competence. Both the cognitive and the emotional levels are influenced by the social context and support (other people's mindsets) of the wider environmental kind of practice that impacts it. In this sense, Illeris gives a framework to see how mindsets influence the learning of SFSCS and vice versa in this present study.

3.4 A conceptualised model showing the key concepts

The model below shows the conceptualisation of the relationships of the key concepts in this present study, such as mindsets and learning of SFSCS. In this study, SFSCS is seen as a tool that deals with the logic and abstraction of numbers, quantities, measurements, shape, space, change and arrangement of objects (Petti, 2018; Hom, 2013). SFSCS learning is a process that is strongly affected by beliefs, which determine how a learner chooses to approach an SFSCS problem and which techniques and strategies he/she uses to tackle the problem. Beliefs also affect motivations (emotional dimension of learning). This, in turn, influences learners' achievements in the learning of SFSCS. Learners' beliefs are sub-divided into three major groups: (i) Beliefs about SFSCS learning (ii) Beliefs about self and (iii) Beliefs about the social context (Viholainen, Asikainen, & Hirvonen, 2014). In general, mindsets are the beliefs people hold about intelligence and abilities in SFSCS and its learning (Bernecker & Job, 2019; Haimovitz & Dweck, 2017; Boaler, 2016; Boaler, 2013; Dweck, 2000).

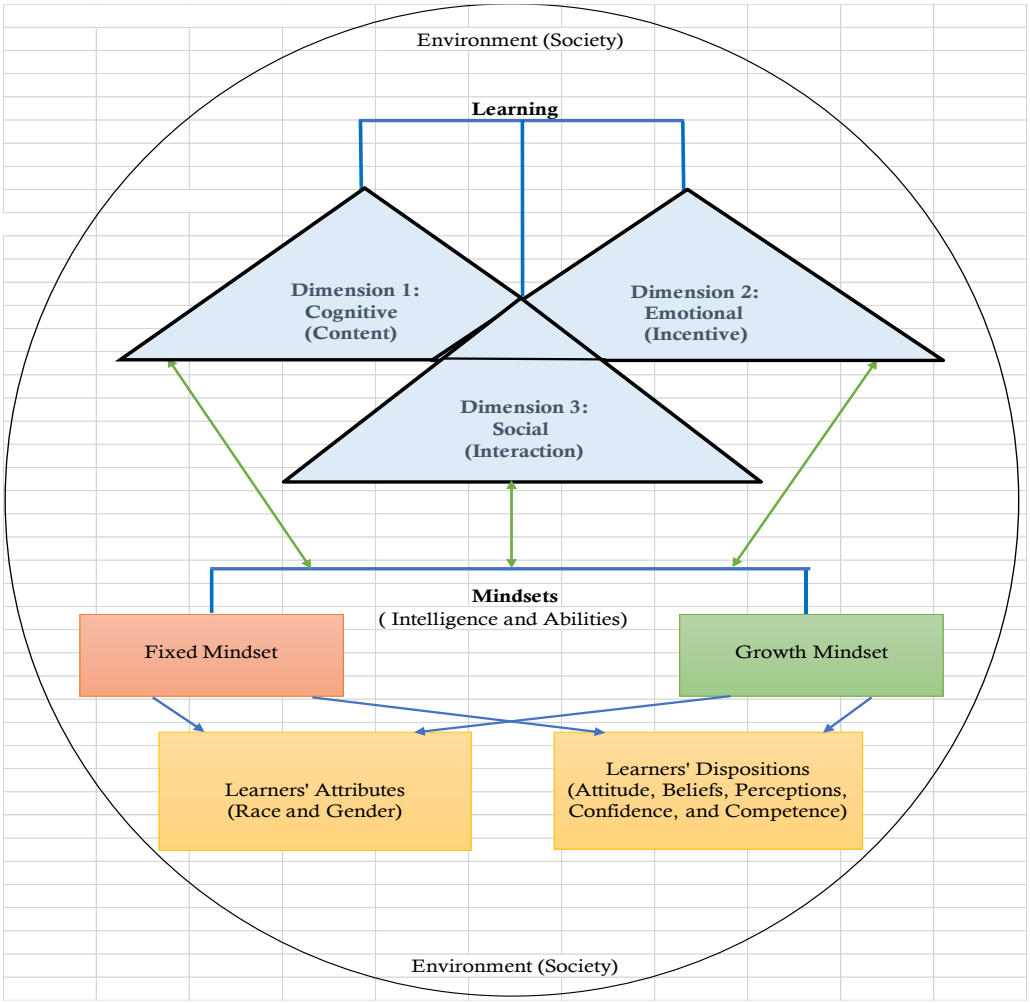


Figure 7: A conceptualised model showing the key concepts

In the circle (i.e. environment) of the model (Figure 7), the trio of dual-headed arrows placed between learning and mindsets depict the learning SFSCS through the lenses of the dimensions of social learning: (a) Cognition dimension – content (knowledge, understanding and skills) (b) Emotional dimension – incentive (energy, desire, determination and volition) (c) Social dimension – interaction (action, participation,

communication and cooperation). The three dimensions work together all the time. For instance, if a learner feels confident, which is emotional (emotional dimension), it affects the learner cognitively (cognitive dimension) and it is constructed socially in relation. In other words, the emotional is cognitive, the cognitive is social. The three dimensions link and overlap all the time. Hence, the three triangles which depict the three dimensions intersect each other, as shown in the model. The three dimensions cannot be treated separately, as argued by Illeris (Illeris, 2009; Illeris, 2003; Illeris, 2002). These dimensions influence mindsets and vice versa.

The model shows the two distinct kinds of mindsets about intelligence and abilities: (i) fixed mindset and (ii) growth mindset. Learners' mindsets involve distinctive qualities that differentiate them (learners) from one another in the learning process, such as the learners' attributes (race and gender) and the learners' dispositions (attitudes, beliefs, perceptions, confidence and competence). These are key concept and qualities of learners' mindsets which underpin this study. According to Dweck (2006), among the factors that have been found to forecast an achievement in learning is the mindsets, such as "the belief that levels of intelligence and abilities are stable plus unable to change – a fixed mindset as opposed to the belief that intelligence and abilities are malleable plus able to develop – a growth mindset" (Destin et al., 2019, p. 2).

At the bottom of the circle of the model are four single-headed arrows mapping from mindsets (fixed mindset and growth mindset) to learners' attributes and learners' dispositions. This depicts that the two distinct types of mindsets have strong influences

on the learners' attributes and dispositions in SFSCS and its learning. These are obtained from the narratives of the participants through interviews with the SFSCS learners and their SFSCS teachers, as well as completed questionnaires that were administered to the learners' parents in the present study. The model, therefore, depicts that learning of SFSCS and mindsets are interrelated. (Zhang, Kuusisto & Tirri, 2017; Claro, Paunesku & Dweck, 2016; Romero, Master, Paunesku, Dweck & Gross, 2014; Boaler, 2013; Dweck, 2012; Schunk, 2012; Yeager & Dweck, 2012; Jarvis, 2006; Dweck, 2000; Heyman & Dweck, 1998).

The learning of SFSCS entails the development of the mindsets the learners hold as a part of the SFSCS community. It is the process of the learners' dealings and experiences with their peers, SFSCS teachers, parents (family) and community, which is the social dimension aspect of learning. This indicates that learners' mindsets are influenced by their peers, teachers, parents (family) and community (Bernecker & Job, 2019; Rissanen, et al., 2019; Sun, 2018; Haimovitz & Dweck, 2017; Haimovitz & Dweck, 2016; Dweck, 2013b; Yeager & Dweck, 2012; Mercer & Ryan, 2010) and their cognition and emotions are simultaneously influenced by these social relations.

3.5 Summary

This chapter discussed some learning theories and some social learning theories. Thereafter, the chapter explicitly discussed the social learning theory that underpinned the present study, Illeris's social learning theory, and the impact Dweck's mindsets

theories have on the three dimensions of social learning regarding a strongly framed and strongly classified subject. The cognitive dimension and emotional dimensions are linked to the learners' fixed and growth mindsets and are constructed socially in relation. Additionally, the social dimension is linked to other people's (learners' teachers, learners' parents and learners' peers) fixed and growth mindsets concerning the learners in the learning process.

More so, Illeris's three dimensions of social learning theory were discussed as well: the cognitive dimension, the emotional or psycho-dynamic dimension and the social dimension of learning. They overlap all the time. The cognitive is emotional, the emotional is social and the social is emotional and cognitive. These dimensions interplay with each other: all of them link all the time. Hence, Illeris argued that these dimensions interplay with each other. They are not separate. The richness of learning is when one works with all these dimensions together, the emotional, the cognitive and the social, and don't treat them separately. The three groups, mislearning, learning defence and learning resistance, are related to all three dimensions. I noted that Illeris's social learning theory is the focus of this study, as it entails the features that are suitable for the present study.

Finally, based on Illeris's three dimensions of social learning and Dweck's mindsets theories, I conceptualised a model that shows the key concepts in this study. The methodology of this present study is discussed in the next chapter.

CHAPTER 4

METHODOLOGY

4.1 Introduction

As indicated in Chapter 1, the focus of this study is an in-depth exploration of the concept of mindsets in strongly framed and strongly classified subjects, using social learning theory and how it relates to and influences learning. This chapter highlights the methodology used in this exploration. The chapter consists of the research design, context of the study and participants, pilot study, data sources and data analysis. Discussion about the rigour (trustworthiness) of the research and ethical considerations are also presented in this chapter.

4.2 Research paradigms

Cohen, Monion and Morrison (2011) assert that, in social science and particularly in education, there are several research paradigms, each of which has its assumptions about knowledge. Cohen, Monion and Morrison (2011) further assert that, in education, there are two predominant research paradigms: (i) Scientific paradigm (positivism), which is seen as predicting and controlling the process of education through knowledge. A positivist is an observer of reality. Positivism is concerned with objectivity, prediction and replicability, as well as scientific generalisations about a phenomenon. (ii) Qualitative paradigm (interpretivism), the intent of which is understanding a

person's meaning-making in contexts, as well as understanding educational phenomena. The knowledge acquired is not objectively, but socially, constructed. Hence, Carson, Gilmore, Perry and Gronhaug (2001) argue that, unlike a positivist paradigm, an interpretivist paradigm circumvents inflexible structural frameworks and implements personal and flexible research structures, which are open to capturing the meanings in human interactions. The researcher is open to new ideas and knowledge in the process of conducting his/her research.

Neuman (2000) posits that it is vital in an interpretivist research study to understand the meanings, reasons, motives and other subjective experiences of the participants who are time and context-bound. Based on the context of this study, as well as a description of mindsets and their implications for SFSCS learning using social learning theory, a qualitative research method is selected as the research design.

4.3 Qualitative research design

Qualitative research is a generic term for investigative methodologies described as ethnographic, naturalistic, anthropological, field, or participant observer research (Key, 1997). Key (1997) asserts that qualitative research underlines the importance of looking at phenomena in their natural settings. It involves an interpretive approach, making sense of phenomena and interpreting them in terms of the meaning people bring to them. Qualitative research is broadly and particularly useful for inductive approaches to generate novel insights into phenomena that are difficult to be measured quantitatively,

as well as for studying educational settings and processes, which usually involve direct interaction with the participants. This is important and detailed data can be gathered through open-ended questions, following up and probing questions, which provide direct quotations where the interviewer is an integral part of the study (Creswell, 2012; Cohen, Monion & Morrison, 2011; Brantlinger, Jimenez, Klingner, Pugach & Richardson, 2005; Denzin & Lincoln, 2003; Key, 1997).

McMillan and Wergin (2002) emphasise that qualitative research focuses on understanding from the perspective of the research participants. It is centered on the assumption that reality is subjective, as well as a function of the context being studied. Taylor and Bogdan (1998) argue that a qualitative approach, in its broadest sense, is research that produces descriptive data – such as participants' own written, spoken words, or observable behaviour. I used qualitative methods of data collection and analysis for this present study, because it enabled me to develop an in-depth understanding of the complex social processes of mindsets and their influence on SFSCS and their learning.

In qualitative research studies, interpretivists argue that "important dimensions of social life and human experience cannot be measured in numeric or quantitative terms. Such researchers are interested in exploring processes and attempt to add depth to our understandings" (Curtis & Pettigrew, 2010, p. 58). Scott and Usher (2011) assert that qualitative research is a prevalent approach for educators, because it offers a more fruitful and human way of conducting research. Qualitative research tends to be field-

focused. Researchers go out into schools and district offices; visit classrooms; observe teaching and learning; interview learners, teachers and other participants; and administer questionnaires to participants where the need arises (Creswell, 2012; Eisner, 1998).

Donohoe, Topping and Hannah (2012) affirm that, since mindsets are complex, "one kind of data was not believed to be adequate. Qualitative measures served to give a more comprehensive picture of the topic and provide insight into the finding(s). More so, it was also important to give the participants a voice" (p. 646). To this end, Creswell (2012) argues that qualitative researchers should triangulate among various data sources to build the trustworthiness of a study. Triangulation is referred to as the "use of more than one method or source of data in the study of a social phenomenon so that findings may be cross-checked" (Bryman, 2012, p. 717). In other words, triangulation is the process involved in the corroboration of evidence from several people, for instance learners, teachers, parents and peers, or different methods of data collection, for example, interviews and questionnaires with detailed descriptions and themes (Bryman, 2012; Creswell, 2012). In this light, triangulation supports the development of a precise and credible research report.

By drawing on different types and sources of data, as well as different methods of data collection, researchers can gain a deeper and clearer understanding of the participants and places being studied. Questionnaires and interviews with learners; interviews with the learners' mathematics teachers; and questionnaires were administered to the

learners' parents in this study. This was to ensure that the data of this study could be triangulated and, with the interviews, I was able to get deeper understandings of how mindsets are constructed in the context of the school and classroom.

This study ends up with what is often called a dense or thick description (Check & Schutt, 2012). A dense description brings out a clear picture of the research participants in the "context of their culture and the setting in which they live, presents detail, context, emotion and the webs of social relationships which join the participants together. In dense descriptions, the voices, feelings, actions and meanings of interacting participants are heard". That is, the detailed descriptions of participants' voices, feelings and actions in a specific research context are elicited (Check & Schutt, 2012; Ponterotto, 2006, p. 541). The interviews and the questionnaires used in this study are aimed at generating such a dense description, as indicated by Check and Schutt (2012).

4.3.1 Case study research design

A research design is an overall plan for a research study that shows how the study will be conducted. A research design is a cord that binds a research study together (Trochim, 2006a). Worthy of note at this point is that the development of a learner's mindset in the study of subjects like mathematics is social in nature. More so, a learner's mindset is regarded as a phenomenon that is socially developed and can be researched using a qualitative design (Cohen, Manion & Morrison, 2007; Wenger, 1998). Suter (2012) asserts that "many description-oriented research questions in education can be answered

by an intensive study of a single person, single group, or similar unit, such as a classroom or school district" (p. 366). This study, therefore, employed a case study qualitative research design.

A case study design is an approach to qualitative research that focuses on a single person or entity [and not the whole population of cases], using a quality and extensive diversity of data in a research study (Suter, 2012; Key, 1997). Key (1997) emphasises that:

> case studies are detailed investigations of individuals, groups, institutions, or other social units. The researcher conducting a case study attempts to analyse the variables relevant to the subject under study. Most studies search for what is common and pervasive. However, in the case study, the focus may not be on generalization, but on understanding the particulars of that case in its complexity. A case study focuses on "a bounded system, usually under natural conditions, so that the system can be understood in its habitat" (p. 2).

In general, case studies are usually carried out for one of the following reasons: (i) To provide vivid descriptions. It is helpful to obtain vividly descriptive pictures of a particular instance (ii) To provide explanations. At times, descriptions are not sufficient in themselves, the "why" of the situation is needed (iii) To provide evaluations. It is to evaluate programs, individuals and settings. Such a study will probably identify programme strengths and shortcomings and will lead to suggested modifications (Mertler & Charles, 2005). With these in mind, this research study has been carried out on the basis of these three reasons, but with more emphasis on the first two.

From the interpretivists' perspective, case studies give an in-depth understanding, viewpoints and ample opportunities to identify and note the impacts mindsets have on SFSCS and their learning, as well as the qualities of the learners, which the learners themselves and their mathematics teachers and parents indicate, as well as the kinds of mindsets the learners have developed which emerge from the learners' qualities. In the process of a case study, there are opportunities to explore and seek, specifically for reasons, for clarification, for asking questions and prompting the learners to give explanations for actions and choices they display towards SFSCS and their learning, as well as their constructed mindsets. A case study can test a theory or build theory, incorporate random or purposive sampling and include qualitative and quantitative data. A "case study may choose a particular person, group of people, or teaching context to investigate a phenomenon that was noticed" (Uwerhiavwe, 2014; Creswell, 2012; Cohen, Monion & Morrison, 2011; O'Toole & Beckett, 2010, p. 6; Creswell, 1998).

In addition, McMillan and Wergin (2002) assert that a case study is "an in-depth analysis of one or more events, settings, programs, social groups, communities, individuals and other bounded systems" (p. 120). Yin (2003) claims that a case study is naturalistic, as it is especially suited to overcome the challenges presented by fragmentation and the associated obstacles to our understanding of research situations, including the delivery of a curriculum that is neither simple nor fragmented and needs to be treated as a whole. Authentic insights reached through a case study have the capacity to work reflexively to change the situation being studied. The action

possibilities created by a case study are grounded in the situation itself, not imposed from outside. A case study can be a thorough examination of a variety of specific phenomena, including an event, institution, person, process, programme, or social group (Hatch, 2002; Merriam, 1998). There are sufficient opportunities, therefore, to examine and record information, as it occurs in the naturally occurring situations and to study the actual behaviour and individuals who have difficulty in their ideas (Creswell, 2012; Thorpe & Holt, 2008; Cohen & Crabtree, 2006). "Case studies may also include multiple cases, in which multiple cases are described and compared to provide insight into an issue" (Creswell, 2012, p.465). Moreover, a collective case study is a case study that consists of several different cases. A collective case study might be conducted at one site (e.g., a school, hospital, or university) by examining a number of different departments or other units at that one site. Each unit is studied as part of a collection, regardless of whether the units themselves are located at single or multiple sites (Creswell, 1998). Regardless of the subject chosen for the investigation, it is vital that the researcher clearly defines the boundaries of the case as a unit of analysis. This is referred to as the key entity that is analysed in a study. The unit of analysis is the “what” or “who” that is under study (Hatch, 2002; Merriam, 1998).

This study primarily seeks answers to research questions based on the social interactions of the learners, teachers and parents in the context of subjects like mathematics and how their mindsets influence the learning of the subject. Learners’ mindsets are mainly developed because of the social relations of the learners, since the

development of a mindset is also social in nature (Cohen, Manion & Morrison, 2007; Wenger, 1998). Following the above and given that a case study is descriptive, interpretive, enlightening and gives in-depth understanding with viewpoints, as well as being suitable and fitting for the goals of this present study, a qualitative case study method was therefore chosen for this project. (Creswell, 2012).

4.4 Context of the study and participants

To identify the relevant individual and schools (in short, the sample) for this present study was critical. It was through a purposeful sampling exercise I obtained the sample (Cohen, Monion & Morrison (2011). Creswell (2012) asserts that:

> in purposeful sampling, researchers intentionally select individuals and sites to learn or understand the central phenomenon. In any given qualitative study, you may decide to study a site (e.g., one college campus), several sites (three small liberal arts campuses), individuals or groups (freshman students), or some combination (two liberal arts campuses and several freshman students on those campuses). Purposeful sampling thus applies to both individuals and sites (p. 206).

With the above in mind, a high school in the Gauteng Province of South Africa was the site of the study with the Grade 9 learners, their mathematics teachers and learners' parents. I made the choice of this site for exploration based on its convenience and the fact that the site was a mixed school in relation to race and gender which entailed Black and White, male and female learners.

There exist two levels of sampling inherent in case study design: the selection of the case to be studied; and the sampling of the participants within the case (Merriam, 1998). In this study, the case to be studied is mindsets and its influence to learning of subjects

like mathematics. In the second level, ten learners, three mathematics teachers and the learners' parents were purposively selected for the in-depth case study.

The selection of these three categories of participants was based on the assumption of multiple realities in the emergent framework. This meant that I proceeded with the expectation that learners, parents and teachers would bring differences in terms of the ways in which they perceived mindsets and how they influence learners learning. In the selection of the ten learners, an information-orientated selection strategy, highlighted by Flynbjerg (2006), was adopted. This is a strategy for the selection of participants that maximised the utility of information from small samples.

Race, gender and achievement in mathematics were the main criteria that were used in the sampling of the participants. The learners' questionnaire (see appendix D) required them to fill in their race and gender. This enabled me to categorise them in these terms. For the level of achievement, teachers assisted me in categorising the learners as low and high achievers, based on their experiences in teaching them and the records of their performance in class. To this end, I categorised those learners with marks between 40% and 59% (both inclusive) in mathematics as low achievers, because marks below 40% indicated that they were not passing, while those learners with 60% and more in mathematics were categorised as high achievers. Based on these characteristics and attributes, as well as willingness to participate in the study, ten grade 9 learners were selected from one high school (see Table 5). In grade 9, there were more Black learners than White learners and more female than male learners in the school. I therefore

randomly selected six female and six black learners within those that satisfied the stated criteria: five of them were low achievers and five high achievers. The ten learners, coupled with their mathematics teachers plus the learners' parents, provided sufficient information for this study.

Table 5: The ten SFSCS learners based on their categories in the school

Learners	Learners' Categories		
	Race	Gender	Achievement
Learner One	Black	Female	High Achiever
Learner Two	Black	Male	Low Achiever
Learner Three	Black	Female	Low Achiever
Learner Four	White	Female	Low Achiever
Learner Five	White	Male	High Achiever
Learner Six	Black	Male	High Achiever
Learner Seven	Black	Female	Low Achiever
Learner Eight	Black	Female	High Achiever
Learner Nine	White	Female	High Achiever
Learner Ten	White	Male	Low Achiever

In a situation where either a learner agreed to participate in the research study and his/her parents disagreed, or a learner disagreed, I replaced that learner with another learner from my compiled list.

4.6 Pilot study

Before the commencement of selection of the participants and data collection for the study, I did a pilot study for a period of two weeks to (i) examine the feasibility of the qualitative case study method, (ii) confirm the adequacy of research instruments, (iii)

ascertain whether the sample size, time and assessment procedures would be appropriate, (iv) reduce errors through testing and modifications of the data collection instruments and (v) validate the questions for the interviews and questionnaires in an attempt to elicit the information that would answer the research questions.

I carried out the pilot study in a similar school with the same characteristics with one learner [who was not in the main study], her mathematics teacher, as well as her parent, on the basis of their consent. The learner was purposefully selected, as were her teacher and her parent. They filled in the consent form (see appendix C). The learner in the pilot study was a White female who was a high achiever in subjects like mathematics. The pilot was done to inform the study. By doing the pilot, I identified and modified a few questions on the SFSCS learners' interview schedules that were not fully understood.

In light of the above, my intention at the beginning was to conduct interviews with all the three categories of the participants. In the pilot study, it was found that it is difficult to get parents involved in an interview, instead, a questionnaire was found to be more suitable for them. As such, I confirmed and decided to use interviews with the learners and teachers and questionnaires with the parents as the data collection instruments, since the SFSCS learner, mathematics teacher and learner’s parent used in the pilot study found the questionnaire and the interview schedule to be accessible to them and were able to answer the questions in them. The pilot study also helped me to determine and ascertain the sample size (twenty-three) for this study. This was the case, because I was able to determine how much time would be required to either complete the

questionnaire or participate in the interview. The pilot study also helped me to reduce questions in the questionnaire and the interview since the participants in the pilot study found these to be repeated. More so, by doing the pilot, the data collected from it was used to have an idea of the kinds of mindsets and the constituent qualities that the SFSCS learners could develop in the main study. As such, I developed more skills and improved the design of the study, such as the focus, data collection instruments, preparation for and how to analyse the collected data, as well as report what I found. These were done prior to the main study to enhance the trustworthiness of the findings of the main study (Leon, Davis & Kraemer, 2011; McMillan & Schumacher, 2010; Yin, 2009). The pilot revealed that the interviews, as well as the questionnaires, were suitable to be used in this present study.

4.7 Data sources

Mertler and Charles (2005) assert that "the information researchers obtain about people, settings, objects and procedures are called data, which can be recorded in the verbal or numerical form" (p. 35). Qualitative researchers triangulate among different data sources and methods of data collection to enhance the accuracy of their study (Creswell, 2012; Mertler & Charles, 2005).

A primary form of data collection in this present study was through formal interviews with the learners and their teachers. A formal interview involves social interactions where the respondent responds to specific questions asked by the interviewer. A formal

interview is a list of questions that are asked in the same pattern. In a formal interview, the interviewer can discuss and probe whatever information arises from the responses of the respondent(s). Interviews access people's perceptions, meanings, definitions of situations and constructions of reality. More so, it is one of the most powerful ways researchers have of understanding respondents (Punch, 2005). Comprehensive and exhaustive interviews provide the interviewer with in-depth information on the respondents' experiences and the meaning the respondents make of the experiences (Seidman, 1998). Through the interviews in this study, it was possible for me to probe the thoughts, values, perceptions, views, feelings and perspectives of the respondents (Punch, 2005; Wellington, 2000). Patton (2002) argues that among the purposes of interviewing is to allow the interviewer to probe into the respondents' perspectives as everyone perceives the world through his/her own experiences. The interviewer may be able to notice if, or when, respondents misunderstand a question. In this light, the interviewer has the opportunity to explain the meaning of the question, or rephrase the question and probe for more complete answers (McBurney & White, 2004).

There are a number of approaches to interviewing. It can be structured, semi-structured, or unstructured (Fontana & Frey, 2000). Which interview approach to use will ultimately depend on the accessibility of participants, data type, the cost, the aims and the amount of time available (Creswell, 2012). Considering these features, I used semi-structured interviews because they: (i) create a forum for flexible discussion (ii) consist of various key questions augmenting and defining the areas to be explored, (iii) allow

the interviewer to shift in order to pursue an idea or response in more detail, (iv) allow all participants to be asked the same questions within a flexible framework, (v) enhance the collection of exhaustive and comprehensive data with less cost and time when compared to other approaches of an interview and (vi) is more relevant and convenient for this study (Costley, Elliott & Gibbs, 2010; Gill, Stewart, Treasure & Chadwick, 2008; Cohen, Manion & Morrison, 2007; Freebody, 2003). Another quality of semi-structured interviews, according to Creswell (2012), is that they give access to the participants' stories and allow them to tell their stories about vital experiences that are useful to the study. Conducting semi-structured interviews with the learners and their teachers elicited and made explicit their experiences in mathematics and its learning. The ways in which these experiences influenced the learners' mindsets and their implications for an SFSCS and its learning were likewise explored through the semi-structured interviews. The interview is an integral part and one of the valuable methods of data collection. In this present study, the same sequence of questions was posed to every respondent in the same category (learners and teachers) during the interviews, however, there was latitude to use further questions to explore substantial responses that came up (Bryman, 2012).

Prior to the interviews, I ascertained the availability of the ten learners and teachers and confirmed if they were interested, motivated and willing to be interviewed at school. I meticulously documented and audio recorded the discussions in the interviews with the learners and their mathematics teachers. Before the participants were audio-recorded, I

drew their attention to the recorder and told them the reason I was recording the interviews. They gave their consent to be recorded. The learners and their mathematics teachers were comfortable when they discovered that an audio recorder was being used. If they had not been comfortable with the recorder, I would not have used it.

Another primary form of data collection in this study was questionnaires. Generally, questionnaires act as an inexpensive and time-efficient means of collecting data and can vary in complexity from descriptive to explanatory. Questionnaires give the researcher the opportunity to include a range of open and/or closed and structured, which help him/her to observe patterns and draw comparisons during analysis (Punch, 2005). To this end, questionnaires are used in qualitative research. Interpretivists use unstructured questionnaires, because these produce qualitative data, probing the participants' information and providing suitable data for analysis on the strength of the respondents' answers to the questions. The learners' parents could best voice their experiences and their children's experiences in an unconstrained manner. Open-ended questions give more data, as the participants can give information on what is necessary and vital to them, as well as expressing the information using their own words. Semi-structured questionnaires were also used in this study with learners [during the learners' selection process] and parents. These questionnaires contained open-ended questions (Martic, 2018; Trueman, 2018; Reddy, 2018; Surbhi, 2016; Creswell, 2012; Bibby, 2002).

The sample size of this study is twenty-three: the ten learners, three of the learners' teachers and ten of the learners' parents. Time and financial constraints did not enable me to use a sample size greater than twenty-three (Shari, 2012; Seidman, 1998).

The data collection process for the main study was done in a period of four months: February 2018 to June 2018. It is essential to reiterate at this point that data for this study was drawn from the learners' interviews, the teachers' interviews and the learners' and learners' parents' questionnaires. Below, I describe each of these.

4.7.1 Learners' interviews

It is crucial to note that, prior to the interviews with the learners, I explained to the principal of the school the criteria highlighted above and the categories shown in Table 4.1, on the basis of which the learners were participating. More so, I explained to all the Grade 9 learners at the school I used for the research study that I was interested in knowing their experiences of mathematics and its learning. I further informed the learners that my interest was how they worked in their classroom and how they saw mathematics and its learning. I also told the learners that, in the process of the data collection, I would ask them some questions about their views on mathematics and its learning and how they interacted with their teachers and peers in the mathematics classroom. I then gave a brief questionnaire to the learners who were interested and willing to fill it in, based on their consent.

The purpose of conducting the learners' interviews (semi-structured) was to explore and elicit the influence of the learners' mindsets on learning. That is to make explicit the learners' experiences in mathematics and its learning. I developed the questions of the learners' interviews myself. The literature drawn from the theories of mindsets and social learning guided me in framing the questions of the interviews.

Learners' interviews questions consist of thirty-seven items with some probes. The areas it covers are things like the learners' beliefs about mathematics; their attitudes towards, and challenges in, mathematics; their commitment towards mathematics and feelings about the subject; issues about race and gender in relation to learning mathematics, support they have from teachers, peers and family members; and their interactions in the classrooms among others (see appendix E).

I conducted all the interviews with the ten learners. I approached them and discussed the study with them, since they had given their consent. I then made the names of the ten Grade 9 learners' teachers known to the principal, as they had given their consent. Likewise, I liaised with the principal and learners to decide on venues and times for the commencement of the interviews and data collection. I made sure they were comfortable with their decisions. Following this, the interviews were carried out on the premises, at convenient times for the learners.

4.7.2 Teachers' interviews

It is worthy of note that, before the interviews with the learners' mathematics teachers, I explained to them that I was interested in knowing their views about the learners' experiences of mathematics and its learning. I further informed the teachers that my interest was how the learners worked in their classroom and how they saw mathematics and its learning. Thereafter, I told the teachers that, in the process of the data collection, I would ask them some questions about their views on mathematics and its learning. Through the learners' mathematics teachers, I contacted the learners' parents for their views about their children's experiences in mathematics and its learning.

The purpose of conducting the teachers' interviews (semi-structured) was to explore and elicit the influence of mindsets on learning. I likewise developed the questions for the teachers' interviews myself. The literature drawn from the theories of mindsets and social learning guided me in framing the questions of the interviews.

Teachers' interviews questions comprise thirty items with some probes. The areas covered are things that are fundamentally about mathematics learning and are similar to the learners' interviews questions (see appendix F).

I also conducted all the interviews with the three learners' mathematics teachers. I approached the learners' mathematics teachers and discussed the study with them, since they had given their consent. I then made known the names of the ten Grade 9 learners' teachers to the principal, as they had given their consent. I likewise liaised with the

principal and teachers to decide on venues and times for the commencement of the interviews and data collection. I made sure they were comfortable with their decisions as well. Following this, the interviews were carried out on the school premises, at convenient times for the mathematics teachers.

4.7.3 Learners' and Parents' Questionnaires

The purpose of conducting the learners' questionnaires was to assist in identifying the learners and classifying the learners in terms of their race, gender and achievements. I developed the questions for the learners' questionnaires myself. The literature drawn from the theories of mindsets and social learning guided me in framing them. The learners' questions comprised ten items concerning their learning experience. The areas it covered were things such as the beliefs and attitude toward mathematics and its learning, among others (see appendix D). I administered the questionnaires in the classroom to the Grade 9 learners, who had indicated their interest and gave consent to participate in the research. The learners completed the questionnaires and reverted right away in the classroom.

Furthermore, the purpose of conducting the learners' parents' questionnaires is to explore the influence of the mindsets on the learners' learning. I developed the questions of the parents' questionnaires myself. The literature drawn from the theories of mindsets and social learning guided me in framing the questions for the questionnaires as well.

Parents' questions comprised twenty-one items with some probes. The areas it covers were things such as: the perceptions of their children's attitude toward mathematics; the learners' reading and practising mathematics and their beliefs about mathematics; learners born with a special talent in mathematics; their interest and confidence in mathematics; their competence in mathematics and willingness towards the subject; their feelings about mathematics; the amount of support the learners have from teachers, peers and family members; and their interactions in the classrooms; among others (see appendix G).

I mailed all the questionnaires to the ten learners' parents. I approached the learners and discussed the study with them, since they had given their consent. I then made known the names of the ten Grade 9 learners' teachers to the principal, as they had given their consent. I likewise liaised with the learners' parents through the mathematics teachers for the filling in of the questionnaires and data collection. The learners' parents' questionnaires were mailed to the parents through the teachers and the parents returned the completed questionnaires when convenient, through the same process.

4.8 Data Analysis

O'Toole and Beckett (2010) assert that qualitative data analysis is frequently termed as "thick data as it is complex and textured" (p. 170). As such, Yin (2010) underscores five phases of qualitative analysis of data: compiling, disassembling, reassembling, interpreting and concluding. Furthermore, these phases of the analytic process do not

form a linear sequence, however, they have recursive and iterative interactions (Yin, 2010). Hence, data analysis encompasses organizing, accounting for and explaining the data; in short, making sense of data in terms of the participants' definitions of the situation, noting patterns, themes, categories and regularities, so that one can form answers to his/her research questions (Creswell, 2012; O'Toole and Beckett, 2010; Yin, 2010).

Brown and Dowling (1998) argue that bringing the theoretical field and the empirical field together allows for theoretical and empirical claims. The authors further argue that there is a sharp dichotomy between the theoretical field and the empirical field. Such that the theoretical field is the "broad area of academic and/or professional knowledge, research and debates which contains [the] general area of interest", while the empirical field is the "general area of practice or activity or experience about which you intend to make claims" (Brown & Dowling, 1998, p. 18).

There is not one correct approach for qualitative data analysist (Creswell, 2012; Cohen, Monion & Morrison, 2007). In this regard, data are analysed, based on how they suitably fit the aims of the research study (Cohen, Monion & Morrison, 2011, p. 537; Cohen, Monion & Morrison, 2007). In the present study, the theoretical fields are Dweck's mindsets theory and Illeris's social learning theory, while the empirical fields are data collected from learners, teachers and parents.

In the present study, the qualitative data analysis entailed making sense of transcripts derived from the learners' and their teachers' audio-recorded interviews and the parents' questionnaires, by identifying and looking for codes that aligned with the themes to answer my research questions (McMillan & Schumacher, 2010). One of the goals of this analysis was to uncover emerging themes, patterns, concepts, insights and understandings of collected data (Patton, 2002).

According to Sutter (2012), "qualitative studies often make use of an analytical framework – a network of linked concepts and classifications to understand an underlying process. That is, a sequence of events or constructs and how they relate" (p. 344). In developing an analytical framework for this study, I used the inductive process to make the analysis of the data explicit and coherent and to substantiate claims with stronger evidence.

In translating the raw data into a readable form, all the recorded interviews and completed questionnaires were fully transcribed. An iterative process in data coding was conducted, through exhaustive reading and re-reading of the transcripts. "The generated data were initially coded on a line-by-line basis" often refers to as open coding (Mercer & Ryan, 2010, p. 436). Open coding is the aspect of analysis that deals with identifying, naming, categorising and illustrating phenomena that are seen in texts. In other words, it is an interpretive process whereby data is analytically broken down. Thereafter, I employed axial coding for further classification of the data. Axial coding is the aspect of analysis that relates codes (categories) to each other. In other words, axial coding is a

process of interconnecting categories making connections between categories to put data together in new ways (Williams & Moser, 2019). Dweck's theory of mindsets and Illeris's social learning theory provided the theoretical bases for the coding of the data. This enabled a complete identification of relevant codes reflecting the participants' mindsets, which developed in relation to the learning of subjects like mathematics. As such, all the coded data was analysed in terms of the three dimensions of Illeris's social learning theory and the two kinds of mindsets (growth and fixed mindsets) of Dweck's mindsets theory as the themes and relationships. The detail of the analytical framework is presented in Chapter 5.

4.9 Trustworthiness

In qualitative studies, rigour is the trustworthiness of the research instrument(s), collected data, data analysis and findings of a study. Trustworthiness is the quality of deserving trust. Rigour in this present study is crucial and the precision of the findings is fundamental for the results to be valid (Houghton, Casey, Shaw & Murphy, 2013; Cohen, Manion & Morrison, 2007; Golafshani, 2003; Krefting, 1991). According to Trochim (2006b) and Shenton (2004), the quality standards for judging the trustworthiness of a qualitative study are credibility, transferability, dependability and confirmability. These are briefly explained below.

4.9.1 Credibility

This entails establishing that the outcomes of a qualitative study are believable from the participants' perspectives. The question: How congruent are the findings of the study with reality? is handled by credibility (Shenton, 2004). I, therefore, ensured that the findings of this study were consistent with real-life situations. The findings are realistic. The data collected is consistent and has a true value, which enables the data to match other similar natural settings when the comparison is made. This is achieved through triangulation, the use of different methods of data collection: (i) transcripts of audio recording, (ii) discussions from interviews/semi-structured interviews and (iii) completed questionnaires.

4.9.2 Transferability

This is the degree to which the outcomes of a qualitative study can be generalised or transferred to other contexts or settings. This study does not lead to generalisation or transferability. I do not make any claim(s) for generalisation or transferability.

4.9.3 Dependability

In this, the researcher needs to consider and account for the constantly changing context within which the study takes place. It is the responsibility of the researcher to explain any changes which take place in the setting, as well as how the study may be affected by some changes. In this study, I did not encounter any changes in the site chosen for the

study which is a high school in Johannesburg and neither did I encounter any changes in any of the mathematics classes in the school.

4.9.4 Confirmability

This is the degree to which the outcomes of the study can be confirmed or corroborated by other people. I ensured confirmability in the study by corroborating and triangulating the responses of the learners with teachers and the learners' parents, as well as provide an in-depth discussion of the data so that others could use them in their study to confirm or corroborate what this study found (Creswell, 2012; Sutter 2012; Cohen, Monion & Morrison, 2007).

It noteworthy that, in order to achieve triangulation in this present study, interviews with the learners (see appendix E) and their mathematics teachers (see appendix F), together with questionnaires for the parents (see appendix G), were used based on the research questions. To ensure triangulation in this study, I used data from three different methods of data and two sources of data. As such, my goal was to capture the breadth and depth of the learners' experiences through the participants' narratives, as they (learners) engaged in various aspects of learning, in order to ascertain the validity of the data (Nasir & Cooks, 2009).

4.10 Ethical considerations

To conduct a study that involves human beings as the participants, it is imperative for the researcher to be ethical, so that the human rights of the participants will not be

infringed. The researcher must be sensitive and respect the participants of the study (Opie, 2004). I obtained ethical clearance from the University of the Witwatersrand Research Ethics Committee (non-medical) (see appendix A). I likewise obtained permission from the Gauteng Department of Education (see appendix B) concerning the collection of data, as well as access to the high school. Thereafter, I consulted the school's principal who also gave her consent. They filled in the consent forms (see appendix C), which indicated their consent for the school to be used for the data collection of this present study. This study involves the participation of learners below the age of eighteen, their mathematics teachers and the learners' parents. I asked for informed consent from the teachers and the learners' parents, as well as the learners themselves.

Every participant was given the assurance of confidentiality and anonymity. No identifying characteristics are included in the study. Appropriate measures, such as skipping question(s) was taken to resolve questions that might have caused embarrassment to prevent risk or harm to participants. If there were difficult issues, I was not able to handle and resolve amicably, I would not have hesitated to relate the issues to my supervisors for the appropriate and necessary actions (Cohen, Manion & Morrison, 2007). The participants were informed of their right to not answer any questions which could incur any negative consequences. I informed the learners, the teachers and the learners' parents that their participation was voluntary and that they could skip any questions they wished to omit. They could also withdraw their

participation at any time if they were feeling uncomfortable. The participants were also requested to give consent to the interviews, audio recording of the interviews and the completion of the questionnaires. I assured them that these were only to be used for this present study. The participants were asked to sign the invitation to participate in letters and these requested them to keep every discussion confidential.

Qualitative research, like other research, may entail risks in relation to the participants, which may include participants finding their participation in the research stressful, disturbing and psychologically or socially harmful to them (Stefanescu, Ioan, Persson & Stefanescu, 2009). Prior to the commencement of the data collection, I explained the risks the participants might face. Risks are those which reflect the possibility and degree of discomfort that participants might experience, as a result of participating in the research: stress and anxiety, feeling uncomfortable, embarrassed, anxious, or upset, as well as a hidden agenda on the part of the researcher (Uwerhiavwe, 2014; Brewer, 2011; Koocher & Keith-Spiegel, 1990).

I was aware that some issues relating to mindsets, race and gender could be problematic for the participants. As they were below the age of eighteen years, they might not have an in-depth understanding of the questions asked during their interviews. As such, the learners might not be able to answer some of the questions. More so, some learners might be averse to sensitive questions. To forestall these kinds of situations, I was very friendly with the learners, frequently reminding them of their right to skip any questions or opt-out of participating if they were feeling uncomfortable. I specifically do not have

interview questions that probe further about race as it is invasive, hence, I have structured things accordingly. More so, I constantly watched their actions and reactions to see if there were any negative responses in order to resolve the situation(s) amicably and immediately and avoid further risk(s).

The data is kept for a minimum of five years, as per the Ethics Committee Policy on Integrity in Scholarly Research. The electronic data is stored on a password-protected computer. All hard copies of the raw data are stored in a lock-up cabinet at the Wits School of Education. My supervisors and I are the only people with access to the data. After the mandatory storage period of five years, all data will be destroyed.

4.11 Summary

This chapter provided the methodology employed in conducting this present study. A qualitative research method was selected as the research design of this study. A case study design was used as the approach to the qualitative research method, with learners and their mathematics teachers and parents as the participants. A purposeful sample of the combinations of the ten learners was selected, on the basis of race, gender and achievement. I also selected the ten learners' mathematics teachers and the learners' parents.

Triangulation was used to support the development of a credible research report. To achieve triangulation in this study, the data collection was from three sources, through the use of interviews and questionnaires. The interviews were audio-recorded. The

credibility, dependability and confirmability of this study were discussed to account for the quality and rigour. I searched for un-confirming evidence in this study as well. Ethical issues were given consideration. Lastly, an inductive approach was used to analyse the data collected.

I now proceed to the next chapter, which presents the analytical framework for the study.

CHAPTER 5

ANALYTICAL FRAMEWORK

5.1 Introduction

The focus of this study is on an in-depth analysis of the influence of mindsets in strongly framed and strongly classified subjects (SFSCS), like mathematics, on students' learning, using a social learning theory. This chapter presents the analytical framework developed in this study. The Illeris's three dimensions of learning (cognitive, emotional and social) and Dweck's two types of mindsets (growth and fixed) provided the backbone for the development of this analytical framework. As indicated previously, there was no analytical framework that brings together the mindsets theory and social learning theory. Therefore, the analytical framework developed in this study presents one of the major contributions in this field.

Illeris (2009) holds that learning is conceptualised within three dimensions: cognitive dimension, emotional dimension and social dimension. The cognitive dimension is associated with the learning content. That is, this dimension is about what learners learn, which is the knowledge that develops the learners' understandings and their abilities. Secondly, the emotional dimension is linked with mental energy, feelings and motivations, i.e. learners' volition and motivation in learning. This dimension could be termed as the incentive dimension of learning. Lastly, the social dimension is about the

social and societal. This last dimension is different from the two, as they focused mainly on the internal frame of a learner. This dimension is concerned with learners' interaction process, as other people are involved in one way or the other and it is linked to society, thereby providing external support for learning to happen, as well as learners' integration in communities (Illeris, 2015; Illeris, 2009; Illeris, 2007; Illeris, 2003; Illeris, 2002). It is important to note that the three dimensions of learning are not mutually exclusive in the empirical space. They were differentiated here simply for analytical purposes. Through extensive working with the empirical data in this study and the theoretical field, each dimension of Illeris's social learning theory is subdivided into two broad categories: (a) a growth mindset - beliefs that intelligence and smartness can be learned, i.e. people have the capacity to learn and grow and (b) a fixed mindset - belief that people's intelligence and talents are fixed and their destiny is to avoid challenges and failure in life (Dweck, 2012; Dweck, 2000). Codes are used for each of the categories and code identification/recognition rules are provided for each code. While the dimensions and mindsets were drawn from Illeris's and Dweck's theories, much of the codes and the code identification indicators were developed from working with the data obtained from the learners and their mathematics teachers' interviews, as well as learners' parents' questionnaires. As Brown and Dowling (1998) argue: bringing the theoretical field and the empirical field together allows for the development of organisational language that can be used to make meaning of the data.

In the following sections, I provide detail of how each of these codes was conceptualised and operationalised for use in this study.

5.2 Cognitive dimension

As indicated already, the cognitive dimension is about learners' development of mental skills and the acquisition of knowledge in the learning process. In developing the organisational language to make meaning of the data, I examine how the two types of mindsets play out within the cognitive dimension of learning, what I termed cognitive growth mindset and cognitive fixed mindset.

5.2.1 Cognitive growth mindset

Cognitive growth mindset (CGM) provides detail on how the growth mindset played out within the cognitive dimension. The relationship of the cognitive dimension with a growth mindset in learning affords learners' knowledge and understanding of SFSCS in the learning process. For CGM, learners attempt to positively construct meaning and ability to handle real-life challenges and, consequently, build a general personal functionality that affords learning. Knowledge, skills, understanding and attitudes are fundamental aspects of the learning content and are always referred to in the cognitive dimension (Illeris, 2015; Illeris, 2007; Illeris, 2003). More so, CGM entails the tendencies of learners who hold a growth mindset and this leads to a desire for them to learn and then a tendency for them to embrace challenges; persist when faced with setbacks; see effort as the path to mastery; learn from criticism; and derive lesson and

inspiration from the success of other learners. The possible outcome of learners with these tendencies is that they become successful in learning (Appell, 2019; Haimovitz & Dweck, 2017; Dweck, 2000; Popova, 2014; Heyman & Dweck, 1998).

Through analysis of the 10 learners' interviews data, initially, with open coding to axial coding, the following three categories emerged within CGM: (1) learning not innate (2) errors as a resource in learning (3) learning mathematics as valuable. These categories are classified under cognitive dimension, because they are referring to the knowledge that develop understanding and abilities in mathematics and its learning, i.e. the knowledge and understanding of oneself, one's strengths and weaknesses. The categories are briefly discussed below.

(1) **Learning not innate**: It means that intelligence is not gained from birth, it is developed from studying and experiencing things. Learners need to develop their intelligence and capability with studying, reading and learning new things. As such, they are not born with the aforementioned qualities. The environment influences have an impact on them (learners). These qualities and experiences influence learning (Anderson, 2007). To this end, I provide excerpts that exemplify this category below.

164 Interviewer: Must you have to be a 'special' person in order to be good in mathematics?

165 Learner: No, you do not have to be a 'special' person in order to be good in mathematics.

166 Interviewer: Please can you explain?

167 Learner: You do not have to be a 'special' person in order to be good in mathematics because you grow up knowing mathematics if you want to know it. It is a matter of choice and determination to be good at mathematics. To be good is personal interest and willingness [Smiles].

The excerpts above display that a learner does not have to be 'special' for him/her to be good at mathematics – "*You do not have to be a 'special' person in order to be good in mathematics*" (line 167). This depicts that mathematics can be learned by anyone who has an interest and determine to learn. These beliefs are associated with learners who hold a growth mindset, since they are positive about the possibilities of mathematics learners by every individual. This mindset has a vital role in learning, as a learners' interest and determination may lead to success in the subject. This echoed the vital role of growth mindset, as it positively influences learning (Haimovitz & Dweck, 2017; Zhang, Kuusisto & Tirri, 2017; Boaler, 2013; Dweck, 2006a)

(2) **Errors as a resource in learning**: It means that making mistakes is perceived as part of the learning process, as well as a door to self-discovery, as it helps the learners to effectively and independently engage in the learning process and produces better learning outcomes. The perception that is an opportunity to learn. Mistakes are learners' actions that produce an unintentional incorrect answer to a problem in the subject (Botley, 2015). However, mistakes are "important sites for learning". As such, some learners perceive it (the mistake) as a part of, or a resource in the learning process (Botley, 2015; Boaler, 2013, p. 149). In this light, I provide excerpts that exemplify this category below.

128 Interviewer: Does making mistakes help?

129 Learner: Yes, making mistakes helps in mathematics.

130 Interviewer: Why?

131 Learner: Making mistakes helps in mathematics because if you make a mistake and you tell the teacher, the teacher would correct you. This will make you read and understand it better.

The excerpts above display that the learner views making mistakes as a resource in learning a SFSCS – "*Making mistakes helps in mathematics*" (line 129). When the learner was asked to explain why (line 130), she claimed that making mistakes in learning helps as it enables her to study and understand it (subject) better – "*This will make you read and understand it better*" (line 131). The view of mistake as a resource for learner exemplify a growth mindset, since they are positive and enhance learning. The literature suggests that mistakes are a vital avenue for effective learning and development. More so, mistakes grow one's brain (Boaler, 2013).

(3) **Learning mathematics as valuable**: This is similar to what Kilpatrick, Swafford and Findell (2001) refer to productive disposition as part of strands of mathematical proficiency – "habitual inclination to see mathematics as sensible, useful and worthwhile, coupled with a belief in diligence and one's own efficacy" (p.116). It is about mathematics being appreciated, as well as the usefulness of mathematics and its learning to learners. More so, mathematics is a prerequisite in many fields of human endeavours and it (mathematics) is viewed as a compulsory subject, hence every learner

must learn it at a particular level (Kiplagat, Role & Makewa, 2012; Sullivan, 2011). In this sense, I provide excerpts that exemplify this category below.

52 Interviewer: Does it show that mathematics learning is a waste of time or it is useful?

53 Learner: Mathematics learning is useful.

54 Interviewer: Why?

55 Learner: Mathematics learning is useful because emmm you can use mathematics in choosing the other subjects and your future career.

The above excerpts display that the learner perceives mathematics as a useful subject, (i.e., crucial and valuable for choosing other subjects to be learned), as well as applicable in the learner's future career choice – "*Mathematics learning is useful because emmm you can use mathematics in choosing the other subjects and your future career*" (line 55). These are evident in a learner who holds a growth mindset, because they are positive. The literature suggests that mathematics and its learning afford the learning of other related subjects (Obomanu & Adaramola, 2011; Maliki, Ngban & Ibu, 2009; Reyes & Stanic, 1998).

It is noteworthy that the above three categories are grouped under cognitive growth mindset, because they are related to the content of learning (what the learners learn), as well as related to learners who hold a growth mindset, which is seen as having positive consequences on learning, as it affords learning.

Table 6 provides a description, identifying indicators and illustrative examples for each category.

Table 6: Categories and their identifying indicators for cognitive growth mindset

S/N	Category	Code	Description	Identifying Indicator	Illustrative Example
1.	Learning not innate	LI_n	Learners having a strong belief that no one is born with mathematics. That is, learning mathematics is not innate. Efforts and determination are the keys to success in learning mathematics.	• Everyone can learn mathematics. • No one is special. • No mathematics gene. • Not limited to anyone. • Effort and determination	• No, one must not be very intelligent to learn mathematics. So, nobody is born to know it. • Some people say that you must be born with the gene of mathematics, which is not true. More so, I disagree with the saying that you must be very intelligent to learn mathematics because mathematics is a thing of reading, practicing and learning more of it. • You do not have to be a "special" person in order to be good at mathematics because everyone can do mathematics. Mathematics is not limited to anyone. As such, everyone has the space to do mathematics.
2.	Mistakes as a resource in learning	LM_i	Learners' conception of making mistakes as a resource for learning new concepts in mathematics.	• Mistakes help. • Understands better when you make mistakes and get corrected.	• Making mistakes help in mathematics because if you make a mistake and you tell the teacher, the teacher will correct you. This will make you read and understand it better. • Making mistakes helps in mathematics because you can learn a lot from your mistakes. • Making mistakes in mathematics helps because you can see where you are going wrong and you can correct yourself

					[smiles]. By doing that you have known it good enough and improved yourself.
3.	Learning mathematics as valuable	LV_a	Learners' utterances emphasise the value of mathematics and its learning.	• Very useful. • Great subject. • Used for everything. • Key to success in life. • Great with the knowledge. • Helps to know other subjects. • Determining factor in career choices.	• Mathematics is a great subject. You can do almost everything with mathematics. If you want to be a great person, just have a good knowledge of mathematics; and you will be fine. • I want to do better in mathematics because I want to become someone in the future. I want to own my personal business. Mathematics emmm is like a subject that is key to your future and makes you successful in business. • Mathematics is very useful to me at the moment because emmm it (mathematics) helps me to do my Natural Science (NS), like emmm doing my equations (balancing equations) in Natural Science.

5.2.2 Cognitive fixed mindset

Cognitive fixed mindset (CFM) provides details about how a fixed mindset played out within the cognitive dimension. The connection of the cognitive dimension with a fixed mindset in learning suggests that learners' knowledge and understanding of SFSCS has little influence through the learning process. For CFM, learners attempt to negatively construct meaning and ability to handle real-life challenges and consequently build a general personal functionality that constrains learning. Furthermore, CFM involves the tendencies of learners who hold a fixed mindset and this may predispose them not to be smart and, consequently, there may be a tendency for them to avoid challenges, give up easily on a task, see effort as fruitless or worse, ignore useful negative feedback and feel threatened, due to the success of other learners. The possible outcomes of learners with these tendencies are that they may plateau early and achieve less than their full potential – that is, they may not become successful in learning (Appell, 2019; Destin et al., 2019; Haimovitz & Dweck, 2017; Dweck, 2000; Popova, 2014; Heyman & Dweck, 1998).

Through analysis of the 10 learners' interviews data, initially, with open coding to axial coding, the following three categories emerged within CFM: (1) born smart in learning, (2) errors as a setback in learning and (3) learning mathematics as abstract. These categories are grouped under cognitive dimension, because they are related to the knowledge that develops understanding and abilities in mathematics learning. That is the knowledge and understanding of oneself, one's strengths and weaknesses. These categories are briefly discussed below.

(1) **Born smart in learning**: This category is characterised by utterances that indicate intelligence as something gained from birth. That is, intelligence was not developed from studying and experiencing things. This category simply indicates that those that are good at mathematics are born with it, rather than acquiring it through practice. As such, there are assumptions that people develop about human attributes, like intelligence, such as the perception that only learners that were born gifted, special, talented, or intelligent can effectively learn mathematics (Dweck, 2013a; Dweck, 2013b; Carey, 2012; Mercer & Ryan, 2010). To this end, I provide extracts that demonstrate this category below.

11	Interviewer:	Can you tell me about your beliefs about mathematics?
12	Learner:	I will say that mathematics is not for all and it is very complicated.
13	Interviewer:	Please elaborate more.
14	Learner:	Mathematics makes you feel as if you are not smart at all. Emmm mathematics is just difficult. I am not a mathematics person. I am not created to be good at mathematics and it is not created for me.
174	Interviewer:	When you are stuck on a mathematics problem or when you get something wrong, what do you do or say?
175	Learner:	When I am stuck on a mathematics problem, I get angry and leave it. Anyways, I do console myself with the saying that I am not created to be smart in mathematics. Just like, I am not designed by God to be good at mathematics.

The learners' extracts above show that she strongly believes that some learners are born with the intelligence to learn subjects like mathematics effectively, hence, they are smart at mathematics and its learning – "*I am not a mathematics person. I am not created to be good at mathematics*" (line14). More so, she believes some learners are specially gifted or blessed by God to learn mathematics effectively – "*I am not designed by God to be good at*

mathematics" (line 175). As such, she is not a mathematics person. Simply put, being knowledgeable in SFSCS and its learning is innate (inborn). These beliefs are a fixed mindset, because they are negative and they constrain her learning of the subject, since she believes that intelligence and smartness are innate and cannot be learned (Haimovitz & Dweck, 2017; Zhang, Kuusisto & Tirri, 2017; Boaler, 2013; Dweck, 2006b).

(2) **Errors as a setback in learning**: It means that making mistakes or committing errors is viewed as obstacles in the learning process, as well as an indication of the weakness of the learners and they tend to avoid challenges in the learning process. As previously mentioned, mistakes are learners' actions that produce an unintentional incorrect answer to a problem in the subject (Botley, 2015). However, some learners perceive a mistake as a setback in the learning process. This is demonstrated with the excerpts below.

151 Interviewer: Does making mistakes help?

152 Learner: No, making mistakes in mathematics makes me look doom and feel less. So, it does not help in mathematics.

153 Interviewer: Why? Please elaborate more.

154 Learner: Making mistakes does not help in mathematics because it makes you and others see and know your weakness and what you did not get right. However, I do not think that I have that patience and will continue to study it when I make mistakes [smiles].

155 Interviewer: What does making a mistake means to you in mathematics?

156 Learner: Emmm making mistakes means that I am less in mathematics. That is, making a mistake reminds me of being deficient in mathematics and makes me sad. So, I do not like doing what will make me sad.

The learner's utterances in the extracts above show that committing errors or making mistakes discourages learning. Unlike in the growth mindset, where that mistake is seen as a resource, here it is a setback and may lead to exclusion from attending mathematics class. This, in turn, will negatively influence the learner's learning of mathematics, because she does not persist in learning the subject. Invariably, it is viewed as a setback in learning – "*I do not think that I have that patience and will continue to study it when I make mistakes [smiles]*" (line 154). When the learner was asked to explain why she claimed that making a mistake does not help (line 153), she noted that when she makes mistakes in learning, it shows her deficiencies and makes her feels that she is deficient and not smart at mathematics – "*Making mistakes do not help in mathematics because it makes you and others see and know your weakness and what you did not get right*" (line 156). In this light, the learner feels sad about the learning process – "*Emmm making mistakes means that I am less in mathematics. That is, making a mistake reminds me of being deficient in mathematics and makes me sad. So, I do not like doing what will make me sad*" (line 156). These are indications of a fixed mindset, because they are negative and provide constraints to SFSCS learning. Hence, the literature suggests that, when learners who hold a fixed mindset make a mistake, they believe that they are just not smart. This has a negative impact on their learning (Haimovitz & Dweck, 2017; Boaler, 2013).

(3) **Learning mathematics is abstract**: It means that mathematics and its learning are perceived as not beneficial to learners and have no direct benefit to learners in everyday life. This is opposite to what Kilpatrick, Swafford and Findell (2001) refer to as 'productive disposition', which is seen as a key strand of mathematical proficiency. Learners learn and

sustain interest to learn more when they see the usefulness of the subject. That is, mathematics learning is not appreciated, as well as not useful or relevant to learners, such that some learners experience a lack of linking and the subjective irrelevance of the subject in the learning process (Hernandez-Martinez & Vos, 2018). To exemplify this, I provide extracts that demonstrate this category.

62 Interviewer: What can you say about the kind of mathematics you do in the classroom?

63 Learner: The kind of mathematics we do in the classroom is easy for those who understand and know it and difficult for those of us who are managing with it.

64 Interviewer: And what those mean to you?

65 Learner: Emmm mathematics learning is a waste of time. Doing this, doing that. To do what? Why? [smiles].

66 Interviewer: Explain, please.

67 Learner: Mathematics learning is a waste of time because it wastes learners' time doing difficult things without moving forward [smiles].

122 Interviewer: How useful is mathematics for you at the moment?

123 Learner: Emmm mathematics is not useful to me. I am always in the shop with my mother, so we use calculators to add sales.

124 Interviewer: Would you like to be engaged in the study of mathematics in the future?

125 Learner: Not at all, I would not like to be engaged in the study of mathematics in the future because it is not in anyways useful to me.

The above extracts show that some learners perceive mathematics learning as not useful, as well as a waste of time – "*Mathematics learning is a waste of time because it wastes learners' time doing difficult things without moving forward [smiles]*" (line 62) and "*Emmm mathematics is not useful to me. I am always in the shop with my mother, so we use*

calculators to add sales" (line 123). The learner was further asked if she would like to study mathematics in the future (line 124). She responded that she would not like to study the subject in the future, since it is not valuable to her – "*I would not like to be engaged in the study of mathematics in the future because it is not in anyways useful to me*" (line 125). These are pointers to a learner who holds a fixed mindset since there was no room for change. The perceptions constrain learning of the subject and negatively influence learning as well (Destin et al., 2019; Zhang, Kuusisto & Tirri, 2017; Uwerhiavwe, 2014).

It is worth mentioning that the above three categories are grouped under fixed cognitive mindset, because they are related to the content of learning (what the learners learn), as well as related to learners who hold a fixed mindset, which has potential negative consequences for learning.

Table 7 provides a description, identifying indicators and illustrative examples for each category.

Table 7: Categories and their identifying indicators for cognitive fixed mindset

S/N	Category	Code	Description	Identifying Indicator	Illustrative Example
1.	Born smart in learning	LB_o	Learners having a strong belief that those who are good at mathematics are born with mathematics. That is, learning mathematics is inborn.	• Already good. • Not for all. • Gifted. • Blessing. • Talent. • Created like that. • Special person. • Chosen learner. • Cannot change. • Special knowledge.	• You have to be a 'special' person in order to be good in mathematics because if you are knowledgeable in mathematics – you easily do mathematics problems and get it right, then you are a special kind of person. God has created you like that [smiles]. In general, one must be special in order to learn mathematics. • Mathematics is a very wonderful subject because it is not everyone who can do mathematics. That is, mathematics is not for everyone. Good learners of mathematics are destined to learn it because mathematics is like their way of life. More so, mathematics chooses who learns and understands it; and I do not think I am one of those, mathematics has chosen or destined to understand it properly. • Yes, everyone does mathematics but not everyone is smart in mathematics. Not everyone is good or understands mathematics very well. Mathematics is understandable sometimes to learners like us who feel we are not for mathematics. However, mathematics is understandable all the time to the "chosen" learners that mathematics is their path. I just use the word

					chosen to refer to learners that are perfect, intelligent, emmm gifted and smart in mathematics. They always do very well in mathematics class work and examinations.
2.	Errors as a setback in learning	LE_r	Learners' committing errors influence the learners' learning of mathematics.	• Looking stupid. • Feeling less. • Weakness. • Deficient.	• Making mistakes do not help in mathematics because it makes you and others see and know your weakness and what you did not get right. However, I do not think that I have that patience and will continue when I make mistakes [smiles]. • Emmm making mistakes means that I am less in mathematics. That is, making a mistake reminds me of being deficient in mathematics. As such, I do not like doing what will make me sad. • Making mistakes could help in mathematics because it makes you to be asking questions on how to get off that mistake. However, I do make mistakes, but I hate asking questions when I make mistakes because it shows my weakness and makes me feel if I am not ready or smart in mathematics learning [smiles].
3.	Learning mathematics is abstract	LM_a	Mathematics learning is not useful to learners.	• Waste of time. • Not useful. • Other subjects give joy. • Other subjects are fun. • Mathematics is more difficult.	• Emmm mathematics learning is a waste of time. Doing this, doing that. To do what? Why? [smiles]. • Emmm mathematics is not useful to me. I am always in the shop with my mother, so we use calculators to add sales. • I just leave mathematics alone when I am stuck and go to another subject - like Afrikaans that always gives me joy [smiles]. More so, when I look at the problem, I just feel that it is going to take ages to get it right unlike others.

Table 8 below displays a summary of the categories here: cognitive growth mindset and cognitive fixed mindset.

Table 8: Categories of cognitive growth and fixed mindsets

Cognitive Growth Mindset	Cognitive Fixed Mindset
Learning not innate	Born smart in learning
Errors as resource in learning	Errors as a setback in learning
Learning mathematics as valuable	Learning mathematics is abstract

Table 8 shows the cognitive growth mindset (CGM) and the cognitive fixed mindset (CFM) with their respective categories. The categories provide a powerful lens for examining and categorising learners' cognitive mindsets and their influences on mathematics learning.

5.3 Emotional dimension

As indicated in the preceding chapters, the emotional dimension is about the volition, feelings and motivation in the learning process. In developing the organisational language to make meaning of the data, I examine how the two types of mindsets play out within the emotional dimension of learning, what I referred to as emotional growth mindset (EGM) and emotional fixed mindset (EFM).

5.3.1 Emotional growth mindset

The emotional growth mindset (EGM) provides details on how the growth mindset played out within the emotional dimension. The relationship of the emotional dimension to a growth mindset in learning affords learners' potential opportunities for sustained learning of subjects like mathematics. Emotional dimension is about attaining learner's mental balance, at the same time building a personal sensibility. This dimension fuels the energy and motivates learners for the acquisition of learning content, while an interesting and pertinent learning content motivates them (learners) in learning (Illeris, 2015; Illeris, 2009; Illeris, 2002). Furthermore, GEM entails the tendencies of learners as evident by being motivated and confident, as well as the desire to learn and persevere when faced with challenges in the learning process. The possible outcomes of learners with these tendencies are that they tend to try harder to overcome the problem and become successful in learning (Appell, 2019; Haimovitz & Dweck, 2017; Dweck, 2000; Popova, 2014; Heyman & Dweck, 1998).

Through analysis of the 10 learners' interviews data, initially, with open coding to axial coding, the following four categories emerged within EGM: (1) excited when learning, (2) learning through practice and perseverance, (3) learning with confidence and (4) feelings of confidence to learn. These categories are classified under emotional dimension, since they are referring to the mental energy (volition), feelings (emotions) and motivations towards mathematics learning. The categories are briefly discussed below.

(1) **Excited when learning**: This category implies that learners are feeling or showing excitement, such as being enthusiastic, happy and eager to learn mathematics. That is, a

feeling or situation full of activity, joy, interest, or exhilaration (Smith, 2010). In this light, I provide excerpts that illustrate this category below.

22 Interviewer: Can you tell me about your interest in mathematics?

23 Learner: [Sighs] Sir, how can I say it! Interest in mathematics? Sir, I do not know how to explain it. However, I am interested in mathematics.

24 Interviewer: Do you find mathematics interesting?

25 Learner: Yes, I find mathematics interesting.

89 Interviewer: Do you feel happy whenever it's time for mathematics class?

90 Learner: Yes, I feel happy whenever it is time for mathematics class. The advice of my mathematics teacher is good. You know advice is good in mathematics – Play and do it again.

From the above excerpts, it can be seen that learner finds mathematics exciting, hence she is happy whenever it is time for mathematics learning, as well as finds its learning interesting – *"[Sighs] Sir, how can I say it! Interest in mathematics? Sir, I do not know how to explain it. However, I am interested in mathematics*" (line 23) and "*I feel happy whenever it is time for mathematics class*" (line 90). This exhibits a growth mindset, since they are potentially positive, they enhance the learning of the subject. It is crucial to note that learners who have constructed a growth mindset in mathematics revealed a substantial increase in their interest, valuing and enjoyment of the subject (Uwerhiavwe, 2014; Boaler, 2013).

(2) **Learning through practice and perseverance**: This category implies learners' rehearsal and repetition, as well as continued effort to learn more mathematics, despite difficulties, failure, or opposition. That is the action, condition, or instance of rehearsing and persevering in the learning process. It is also about learners' need to put effort and time into practice and

be conversant with new learning opportunities (Santos, 2019; Dweck, 2013c; Dweck, 2000). In the excerpts below, I provide an illustrative example of this category.

90 Interviewer: Do you read and practice mathematics?

91 Learner: Yes, I do read and practice mathematics.

185 Interviewer: When you are stuck on a mathematics problem or when you get something wrong, what do you do or say?

186 Learner: When I am stuck on a mathematics problem, I continue to put effort and I get my teacher to help me and show me the right way if I could not get the answer. As soon as he helps me, I feel much better and I see where I went wrong.

The above abstracts exhibit that the learner reads and practices an SFSCS regularly to have good knowledge of it (mathematics) – "*I do read and practice mathematics*" (line 91). More so, the learner does not quit when she is faced with challenges when solving mathematics problems – "*When I am are stuck on a mathematics problem I get very down, but then I get my teacher to help me and show me the right way. As soon as he helps me, I feel much better and I see where I went wrong*" (line 186). These are associated with a learner who holds a growth mindset, because it is positive and it affords success in the learning of the subject, as the learner can grow his/her intelligence and ability stronger over time by studying with perseverance (Appell, 2019; Haimovitz & Dweck, 2017; Popova, 2014).

(3) **Learning with confidence**: This category implies learners' state of mind or manner that points to freedom from uncertainty or shyness in the learning process. Simply put, it is a lack of fear, the opposite of being shy, or being uncertain and having faith in their (learners) own abilities. The learners' have confidence in their attitudes regarding their own skills and

abilities, such that they (learners) accept and trust themselves. A learners' faith in themselves and capabilities is a learner's self-assurance, a belief in his/her own ability to succeed or be good at learning (Dabell, 2017; Darragh, 2013; Parsons, Croft & Harrison 2011). Below I provide an illustrative example of this category.

29 Interviewer: Please tell me about your confidence in mathematics?

30 Learner: Well, if I believe in myself, I can do better in anything. As such, since I believe in myself in mathematics, I know I can do better and I can do better than anything [smiles]. I will say that I am confident in mathematics.

From the above, it can be seen that the learner is confident in mathematics – "*I believe in myself in mathematics, I can do better than anything [smiles]. I will say that I am confident in mathematics*" (line 30). This is a pointer to a learner who holds a growth mindset, which is potentially positive and affords learning of the subject. As evident in the literature, learners who are confident in learning hold a growth mindset. This enables the learner to do what he/she wants to do successfully and it affords an understanding of the subject in learning. As such, learners need to demonstrate confidence to be successful in learning (Darragh, 2013; Graven, 2013; Bishop, 2012).

(4) Feeling competent to learn: This category implies the ability to do something or learn successfully and/or efficiently. In other words, a learner learns with competence when he/she is capable in the learning process, such that when he/she has the ability, fitness or quality needed to learn effectively. That is, the learners' capacity to acquire expected knowledge or skills (learning goals) in the learning process (Holsbeeke, Ketelaar, Schoemaker & Gorter, 2009). Below I provide excerpts that illustrate this category.

37 Interviewer: Do you feel competent to do mathematics?

38 Learner: Yes, I feel competent to do mathematics.

39 Interviewer: Do you pass mathematics examinations easily?

40 Learner: Yes, I do pass mathematics examination because I am competent to do mathematics. Emmm in short, I pass mathematics [smiles] quiz always; so, I am competent in mathematics.

The above abstracts by the learner exhibit that she is competent in doing an SFSCS since she passes mathematics examinations – "*I feel competent to do mathematics. Emmm in short, I pass mathematics [smiles] quiz always*. *So, I am competent in mathematics*" (line 38; line 40). This is related to a learner who holds a growth mindset, because it is positive and it affords her to be successful in learning. The literature suggests that every learner needs to be competent in the study of SFSCS to enable him/her to be successful in learning. If a learner is competent, he/she is perceived to be good at the subject (Darragh, 2013).

It is noteworthy that these four categories are classified under emotional growth mindset, because they are related to volition, feelings and motivation in the learning process, as well as related to learners who hold a growth mindset, which previous research has linked to positive consequences for learning: it affords learning.

Table 9 provides a description, identifying indicators and illustrative examples for each category.

Table 9: Categories and their identifying indicators for emotional growth mindset

S/N	Category	Code	Description	Identifying Indicator	Illustrative Example
1.	Excited when learning	LE_x	Learners verbalize feelings of excitement and joy when learning mathematics.	• Mathematics is exciting. • Feeling happy. • Interested. • Inspired.	• I do say that - mathematics is interesting and mathematics is exciting and inspiring [smiles]. • [Laughs] Yes, I feel happy whenever it is time for mathematics class. • I find mathematics very interesting because I learn more about mathematics.
2.	Learning through practice and perseverance	LP_e	Learners put more effort and resist giving up on difficult task when learning mathematics. Learners appreciate productive challenges when learning mathematics.	• Keep on trying. • Never quit or give up. • Determined. • Committed. • Battling through. • Practice and practice.	• My interest in mathematics is understanding it and battling it through. • So, I need to read and practice mathematics day in and day out as well to make it easier for me. • Mathematics seems difficult at the beginning, but when you practice and practice it you find out that in the end it is easy and gets better.

3.	Learning with confidence	LC_n	Learners demonstrate feelings of confidence in learning mathematics.	• Have confidence. • Good at mathematics. • Inspired. • Move on smoothly. • Being comfortable with mathematics.	• I will describe myself in mathematics learning as being confident because I know what to do to know more about mathematics [smiles]. • I was not confident in doing mathematics last year because I was so playful. This year, I am confident in doing mathematics because I am not playful; more so, I have a teacher that inspires me in mathematics as well. • Yes, I feel accepted and comfortable mathematics classroom because our teacher, Mr. Vuyo is the best teacher, he helps me to understand mathematics very well. At the moment, I am fine with what I was scared of and did not understand in mathematics last year.
4.	Feeling competent to learn	LC_m	Learners verbalize feelings about competence in learning mathematics.	• Have competence. • Feeling competent. • Can make it. • Mathematics is easy.	• Yes, I do feel competent that I can do mathematics. • Well, when mathematics is challenging, I feel that I can make it. Sometimes I am so proud, I feel like helping others who do not understand so that they will not be like me when I wanted to quit mathematics. • Yes, I am competent to do mathematics.

5.3.2 Emotional fixed mindset

Emotional fixed mindset (EFM) provides details on how a fixed mindset played out within the emotional dimension. The connection of emotional dimension with a fixed mindset in learning constrains learners' knowledge and understanding of mathematics. Furthermore, EFM entails the tendencies of learners who hold a fixed mindset not to be motivated, as well as lack self-confidence and a desire to learn and persevere when faced with challenges in learning. As such, the learners develop the tendency to avoid challenges, give up easily on a task and perceive effort as fruitless. The possible outcomes of learners with these tendencies are that they may plateau early and achieve less than their full potential; they may not become successful in mathematics learning (Appell, 2019; Haimovitz & Dweck, 2017; Dweck, 2000; Popova, 2014; Heyman & Dweck, 1998).

Through analysis of the 10 learners' interviews data, initially, with open coding to axial coding, the following four categories developed within EFM: (1) bored when learning, (2) laissez-faire attitude towards learning, (3) learning with uncertainty and (4) learning with inadequacy. These categories are grouped under emotional dimension, as that they are related to the mental energy (volition), feelings (emotions) and motivations towards mathematics and its learning. These categories are briefly discussed below.

(1) **Bored when learning**: This category implies that learners are not feeling or showing excitement, such as not being enthusiastic and eager about learning. They do not have a feeling or situation full of activity, joy, interest, or exhilaration. In this context, being bored when learning implies that the learners felt weary and lacked interest in mathematics

activities, lacked attention, or had nothing to do, i.e. experiencing boredom in the learning process (Gafoor & Kurukkan, 2015). Below I provide assertions that exemplify this category.

96 Interviewer: Is mathematics learning fun or boring?

97 Learner: Mathematics learning is too boring, Sir.

98 Interviewer: Explain why, please.

99 Learner: Mathematics learning is boring because it is problem-solving.

102 Interviewer: Do you feel happy whenever it's time for mathematics class?

103 Learner: Not really, Sir. I do not feel happy in mathematics class because it is not the right environment to be in.

The above assertions exhibit that the learner is bored in mathematics and its learning – "*Mathematics learning is too boring, Sir*" (line 97). More so, the learner does not feel happy when he is in mathematics class – "*I do not feel happy mathematics class because it is not the right environment to be in*" (line 103). These illustrate a learner who holds a fixed mindset. These negative attitudes have negative consequences for learning, as they constrain effective learning of the subject. It is noteworthy that, if a learner has a negative attitude towards mathematics and its learning, this will reflect on his/her performance in the subject and other related subjects negatively (Uwerhiavwe, 2014; Darragh, 2013; Maliki, Ngban & Ibu, 2009).

(2) **Laissez-faire attitude towards learning**: This category implies learners are lazy to practise or rehearse mathematical work. The category of feelings is also evident when learners demonstrate a lack of interest when they encounter difficulty with mathematical workings. This is the action, condition, or an instance of not rehearsing and persevering in the learning process. As such, when a learner claims that he/she is tired of learning, it is a pointer

that the learner is lazy as well. In this context, the learners lack the determination to learn mathematics, which is a positive emotional attitude that entails persevering towards a goal irrespective of any difficulties they might encounter. In other words, a learner's determination could be seen as the engine which drives his/her perseverance in the learning process (Deloumeau-Prigent, 2017; Jamnik, 2014; Oxford Dictionaries, 2013). Below, I provide a transcript from the interviews that exemplify this category.

105 Interviewer: Do you read and practice mathematics?

106 Learner: No ooo, I do not read and practice mathematics. I read other subjects that interest me.

204 Interviewer: When you are stuck on a mathematics problem or when you get something wrong, what do you do or say?

205 Learner: I am always cross when I am stuck on a mathematics problem. I take a break and do not go back to it most times because I will still get stuck if I go back to it. However, I do not bother. All I need at the moment is just to manage a pass and move forward.

The above assertions exhibit the learner's disposition of being lazy and a lack of determination [perseverance] in mathematics learning – "*I do not read and practice mathematics. I read other subjects that interest me*" (line 106). More so, the learner does not persist when stuck in a problem, i.e. she quits on problems – "*I am always cross when I am stuck on a mathematics problem. I take a break and do not go back to it most times because I will still get stuck if I go back to it*" (line 205). These are indications of a learner who holds a fixed mindset, as she is negative. Such a learner always perceives efforts pointless as he/she feels that he/she is stupid in SFSCS and its learning. These dispositions constrain learning and may lead to failure in the subject. The literature suggests that, when learners with a fixed

mindset face challenges in mathematics learning, they quit on it. Such learners frequently avoid challenges, instead, they prefer to do easier tasks in which he/she wants to succeed (Haimovitz & Dweck, 2017; Boaler, 2013).

(3) **Learning with uncertainty**: This category implies learners' state of mind or manner that points to uncertainty, or shyness, in the learning process. That is, learners' lack of self-confidence is their attitudes regarding their own skills and abilities, such that they (learners) do not accept and trust themselves: the learners' lack faith in themselves and their capabilities. Simply put, it (uncertainty) is a learner's lack of self-assurance, a belief in his/her own ability to succeed or be good at learning (Dabell, 2017; Darragh, 2013; Parsons, Croft & Harrison 2011). To this end, I provide assertions that exemplify this category below.

36 Interviewer: Please tell me about your confidence in mathematics?

37 Learner: I do not have confidence in mathematics.

38 Interviewer: Explain why.

39 Learner: I do not have confidence in mathematics because emmm when the teacher asks a question and I would not know it or how to answer it because the class will be looking at me and emmm I am afraid and do not know what they (teacher and other learners) are going to say. I will be shy maybe when I give a wrong answer, the class will look at me.

There is an indication from the learner's assertions above that he is not confident in SFSCS and its learning. That is, the learner lacks self-confidence in mathematics learning – "*I do not have confidence in mathematics*" (line 37). When the learner was asked to explain why he lacks the self-confidence to do mathematics (line 38), he claimed that he does not how to answer questions, as he is shy and scared – "*I do not have confidence in mathematics because*

emmm when the teacher asks a question and I would not know it or how to answer it because the class will be looking at me and emmm I am afraid and do not know what they (teacher and other learners) are going to say. I will be shy maybe when I give a wrong answer, the class will look at me" (line 39). These are revelations of a learner who holds a fixed mindset and they are negative, since they constrain learning. As evident in the literature, learners who are not confident in learning hold a fixed mindset. This does not enable the learner to do what he/she wants to do successfully - it constrains success in learning. More so, the literature suggests that learners need to demonstrate confidence to be successful in learning. This implies that a lack of confidence in SFSCS learning may lead to failure in the learning as well (Darragh, 2013; Graven, 2013; Bishop, 2012).

(4) **Learning with inadequacy:** This category implies the lack of ability to do something or learn successfully and/or efficiently in the learning process. The learners lack the capacity to acquire expected knowledge or skills (learning goals) in the learning process. In other words, a learner learns with inadequacy (lack of competence) when he/she is not capable in the learning process, when he/she lacks the ability, fitness, or quality needed to learn effectively. That is, the learner lacks the capacity to acquire expected knowledge or skills (learning goals) in the learning process (Holsbeeke, Ketelaar, Schoemaker & Gorter, 2009). In this light, I provide assertions that exemplify this category below.

40 Interviewer: Do you feel competent to do mathematics?

41 Learner: No ooo, I do not feel competent to do mathematics.

42 Interviewer: Do you pass mathematics examinations easily?

43 Learner: No, I do not pass mathematics examinations easily. I guess I am not competent enough because I am always scared when it comes to the time for mathematics learning.

44 Interviewer: Do you think that you are good at mathematics?

45 Learner: No ooo, I am not good at mathematics.

46 Interviewer: Why?

47 Learner: I am not good at mathematics given that I failed my grade last year because of mathematics since I am not competent [smiles].

The above assertions by the learner exhibit that he is not competent in doing an SFSCS. That is, he lacks self-competence to do mathematics, hence he is not good at the subject and its learning – "*I do not feel competent to do mathematics*" (line 41) and "*I am not good at mathematics given that I failed my grade last year because of mathematics since I am not competent [smiles]*" (line 47). Such dispositions are associated with a learner who holds a fixed mindset, as they are negative and constrain the effective learning of an SFSCS. The literature suggests that every learner must be competent to study an SFSCS. Invariably, a learner who is not competent in SFSCS learning will not be able to learn an SFSCS effectively, as a lack of numerical competencies has a negative influence on learning (Bansilal, Webb & James, 2015; Darragh, 2013).

It is worthy of note that these four categories are classified under emotional fixed mindset, because they are related to the content of learning: volition, feelings and motivation in the learning process, as well as related to learners who hold a fixed mindset, which has negative consequences for learning, as it constrains learning.

Table 10 provides a description, identifying indicators and illustrative examples for each category.

Table 10: Categories and their identifying indicators for emotional fixed mindset

S/N	Category	Code	Description	Identifying Indicator	Illustrative Example
1.	Bored when learning	LB_r	Learners demonstrate feelings of boredom when learning mathematics.	• Mathematics is boring. • Feeling tired.	• Mathematics learning is boring because it is problem-solving. • Yes, a few of the subjects are boring like mathematics, while the others are not boring. • My attitude towards mathematics learning is emmm I feel tired to learn it.
2.	Laissez-faire attitude towards learning	LL_a	Learners are lazy in learning mathematics. The learners refrain from drilling in learning mathematics. That is, learners lack determination in learning mathematics.	• Leave it. • Feeling defeated. • Give up. • Quit. • Do not come back. • Do not continue. • Not ever get it. • Do not read. • Do not practice. • Do not put effort. • Not determined. • Not committed.	• When I am stuck on a mathematics problem, I look stupid and do say that mathematics is not my way. More so, I just leave mathematics alone when I am stuck and go to another subject - like Afrikaans that always gives me joy [smiles]. More so, when I look at the problem, I just feel that it is going to take ages to get it right. As such, I just leave it. • I am always cross when I am stuck on a mathematics problem. I take a break and do not go back to it most times because I will still get stuck if I go back to it. • No ooo, I do not read and practice mathematics. I read other subjects that interest me.

3.	Learning with uncertainty	LU_n	Learners are uncertain about learning mathematics and uneasy with the learning.	• No confidence. • Do not have confidence. • Not confident. • Not comfortable. • Not feeling comfortable. • Scared. • Nervous. • Shy.	• I do not have confidence in mathematics because emmm if I do work in mathematics - like equations, I lose confidence. • I do not have confidence in mathematics because emmm when the teacher, Mr. Kabelo asks a question and I would not know it or how to answer it because the class will be looking at me and emmm I am afraid and do not know what they (teacher and other learners) are going to say. I will be shy maybe when I give a wrong answer, the class will look at me. • Just because I am nervous when it comes to mathematics. This is so because it is difficult to understand most of the principles in mathematics. As such, I do not feel comfortable with mathematics.
4.	Learning with inadequatenes s	LI_n	Learners verbalize feelings about inadequacy in learning mathematics.	• Not competent. • No competence. • Not feeling competent. • No understanding. • Cannot do mathematics.	• No ooo, I do not feel competent to do mathematics. • Emmm no, Sir. I do not feel competent to do mathematics; this is because I am somehow scared when solving mathematics problems. Like I said mathematics is not a path; I am just managing myself to do mathematics since it is a must to do at the moment [smiles]. • No, Sir. I do not feel competent to do mathematics. I feel that I am not for mathematics. However, I still pass it (mathematics) most times. The thing is, some of us know mathematics, while some of us do not know it. So, I am not competent because I am not for mathematics.

Table 11 displays a summary of the categories of emotional growth mindset and emotional fixed mindset.

Table 11: Categories of growth and fixed emotional mindsets

Emotional Growth Mindset	Emotional Fixed Mindset
Excited when learning	Bored when learning
Learning through practice and perseverance	Laissez-faire attitude towards learning
Learning with confidence	Learning with uncertainty
Feeling competent to learn	Learning with inadequateness

Table 11 depicts two categories and their respective identifying indicators. The emotional growth mindset (EGM) and the emotional fixed mindset (EFM) have consequences for SFSCS and its learning. The EGM affords SFSCS and its learning: it positively influences learners' volition, feelings and motivation in the learning process learning. However, EFM constrains SFSCS and its learning: it negatively influences learners' volition, feelings and motivation in the learning process learning (Boaler, 2016; Yeager & Dweck, 2012; Illeris, 2009; Maliki, Ngban & Ibu, 2009; Dweck, 2006a).

5.4 Social dimension

As indicated in the previous chapters, the social dimension is about learners' interactions that occur in the learning process. In developing the organisational language to make meaning of

the data, I examine how the two types of mindsets play out within the social dimension of learning, what I called social growth mindset and social fixed mindset.

5.4.1 Social growth mindset

Social growth mindset (SGM) provides details on how the growth mindset played out within the social dimension. The relationship of the social dimension with a growth mindset in learning affords learners' knowledge and understanding of SFSCS in the learning process. The social dimension is about learners' external interactions, like participation, communication and cooperation that occur in the learning process. This provides learners' integration in communities, as well as society. In a process whereby learners integrate themselves into a community (society), they interact with the community. Concerning SGM, the form of interactions extends from its simplest to more engaged forms, such as participation, perception, communication, experience, activity and imitation (Illeris, 2009; Illeris, 2007; Illeris, 2003). Furthermore, SGM entails the tendencies of learners', who hold a growth mindset, desire to interact and integrate with the community for them to learn more and, consequently, derive lessons and inspiration from the success of other learners. The possible outcomes of learners with these tendencies are that they tend to try harder to overcome the problem and become successful in learning (Appell, 2019; Haimovitz & Dweck, 2017; Dweck, 2000; Popova, 2014; Heyman & Dweck, 1998).

Through the analysis of the 10 learners' interviews data, initially, with open coding to axial coding, the following three categories emerged within SGM: (1) learners' attribute inconsequentiality in learning, (2) learning through participation and (3) learning through

support. These categories are classified under social dimension, because they are referring to the interaction process, such as participation, communication and cooperation in mathematics learning. These categories are briefly discussed below.

(1) **Learners' attribute inconsequentiality in learning**: This category is evident when participants considered learners' race and gender as not being an influence on their learning of mathematics. Simply put, effective learning is not influenced by the learners' race and gender, which, in turn, impacts their [academic] achievement in the learning process (Becares & Priest, 2015). This category is particularly important in a South African context, as race was a big issue during the apartheid era and schools were segregated based on race. Below I provide quotes that demonstrate this category.

127 Interviewer: Are males naturally better in mathematics than females?

128 Learner: The saying that males are smarter than females in mathematics is just a belief. However, I do not believe that boys are smarter than girls in mathematics. If I must say, I think females are smarter than males in mathematics from my own perspective. The actual sense is that both are equal in mathematics learning.

142 Interviewer: Have you ever thought of race in mathematics learning?

143 Learner: No, I have never thought of race in mathematics because anyone can learn mathematics.

144 Interviewer: Does being intelligent to learn mathematics have any relationship with your race?

145 Learner: No, being intelligent to learn mathematics does not have any relationship with one's race.

146 Interviewer: If yes/no, why?

147 Learner: Race does not have anything to do in terms of learning mathematics. There are Black teachers and there are White teachers who know and teach mathematics. More so, there are Black learners and there are White learners who know mathematics. So, race does not have anything to do with mathematics. Being intelligent in mathematics is all about the individual. That is, it is all about how one does it.

The learner's utterances depict that his level of capability in mathematics and its learning is not linked to race or gender – "*Being intelligent to learn mathematics does not have any relationship with one's race*" (line 145) and "*The saying that males are smarter than females in mathematics is just a belief. The actual sense is that both are equal in mathematics learning*" (line 128). That is, being intelligent in SFSCS learning has no link with learners' attributes: race and gender. Learners' race and gender do not influence their learning, because everyone can effectively learn an SFSCS. These are revelations of learners who hold a growth mindset toward learning, since they are positive and they afford effective learning of the subject. The literature suggests that learners' race and gender do not influence learning. Put simply, race and gender do not affect learners' capabilities to learn effectively (Haimovitz & Dweck, 2017; Boaler, 2013; Martin, 2006; Nasir & Hand, 2006; Skovsmose, 2005; Reyes & Stanic, 1998).

(2) **Learning through participation**: This category emphasises the active learners' engagement, involvement, or contribution classroom activities. In other words, learners' participation could be any activity from asking questions to leading discussions in the classroom. Such as learners' participation, interactions, communication and cooperation. Learning through participation is a category of the social dimension that is crucial and necessary for the learning process (Merchant, 2009; Handley, Sturdy, Fincham, & Clark,

2006; Wenger, 1998; NCTM, 1989). Below, I provide an illustrative example that demonstrates this category.

201 Interviewer: Do you assist your peers (classmates/other learners) in doing their mathematics assignments (classwork)?

202 Learner: Yes, I assist my peers in mathematics group classwork if they do not understand what I know; I help them. I teach and explain problems to them.

The above quote depicts that the learner socially participates in classrooms by teaching her classmates during class tasks, as well as solving mathematics problems and explaining the procedure to them (classmates) – "*I assist my peers in mathematics group classwork if they do not understand what I know; I help them. I teach and explain to them*" (line 202). These dispositions are indications of a growth mindset since they are positive and they afford learning. The literature suggests that learners' involvement in conversational practices helps in their learning (Bishop, 2012; Noren, 2011).

(3) **Learning through support**: It infers the support that learners get from their mathematics teachers and peers at school in the learning process, as well as the support that learners get from their parents (family members) at home. That is, what the learners' mathematics teachers, peers and parents do to help them (learners) in the learning process (Riester-Wood, 2015; Bates, 2014; Johnston, 2009). As such, I provide quotes that demonstrate this category below.

164 Interviewer: How would you describe your relationship with your mathematics teacher?

165 Learner: My mathematics teacher is very helpful, happy and friendly. If you told him (teacher) something, he does not shout at you, he is always ready to teach you any time.

199 Interviewer: Do your peers (classmates/other learners) help you in anyways help you when you need assistance in mathematics learning?

200 Learner: Some of my classmates help me when I need their assistance in mathematics learning.

201 Interviewer: Explain how.

202 Learner: Some of my classmates are really clever, so they understand the work. When I ask them for help, they do help me.

203 Interviewer: Do your peers (classmates/other learners) assist you in doing your mathematics assignments (classwork)?

204 Learner: Yes, my peers assist me in mathematics if we are working in a group, we do assist each other. That is the essence of group work.

214 Interviewer: Do any of your family members (siblings, parents, or guidance) contribute to your mathematics learning?

215 Learner: Yes, my family members contribute to my mathematics learning.

216 Interviewer: Explain how, please.

217 Learner: My family members contribute to my mathematics learning by always teaching and pushing me to study, do better and pass at the end of the year to help me to go to the next grade.

218 Interviewer: Do any of your family members (siblings, parents, or guidance) assist you in doing your mathematics assignments (homework)?

219 Learner: Yes, my family members assist me with my mathematics homework.

240 Interviewer: How has what they (other learners, teachers, or family members) said made you think about mathematics?

241 Learner: Well, the way my brother and Mr. T3 say about mathematics is pushing me to do my work and think good about mathematics at the end of the day [smiles].

The learner's quotes above depict that he gets the amount of support he needs in an SFSCS and its learning at home from her parents (family members), as well as the support she needs

from her peers and SFSCS teacher at school – "*My peers assist me in mathematics if we are working in a group, we do assist each other. That is the essence of a group work*" (line 204); also, "*My family members contribute in my mathematics learning by always teaching and pushing me to study, do better and pass at the end of the year to help to go to the next grade*" (line 217). These are associated with a growth mindset because they are positive and enhance learning. When learners are receiving the necessary support needed for effective learning from their teachers, family members and peers, it assists in the learning process (Martin, 2006; Nasir & Hand, 2006; Reyes & Stanic, 1998).

It is worth mentioning that the above three categories are classified under social growth mindset, because they are related to the learners' interaction or social process. This is because there are always other people who are involved, directly or indirectly, in the learning process and it is connected to society. More so, the three categories are related to learners who hold a growth mindset, which has positive consequences for learning, as it affords learning.

Table 12 provides a description, identifying indicators and illustrative examples for each category.

Table 12: Categories and their identifying indicators for social growth mindset

S/N	Category	Code	Description	Identifying Indicator	Illustrative Example
1.	Learners' attribute inconsequentiality in learning	LA_i	Learners' race and gender do not influence their mathematics learning.	• Intelligence is not related to race. • Complexion does not change knowledge. • Colour does not change knowledge. • Smart Blacks and Whites. • Learning is not a gender thing.	• No. Race does not have anything to do in terms of learning mathematics. There are Black teachers and there are White teachers who know and teach mathematics. More so, there are Black learners and there are White learners who know mathematics. So, race does not have anything to do with mathematics. Being intelligent in mathematics is all about the individual. That is, it is all about how one does it. • Being intelligent to learn mathematics does not have any relationship with one's race because your race or complexion does not change your knowing mathematics or not. Since we have both White and Black learners who are smart in mathematics and who are not smart in mathematics learning. • Males are not naturally better in mathematics than females. It is just that the males think that everything must be about them and they (males) must know everything about mathematics. I must say that there are females who master mathematics more than males. So, mathematics is not a gender thing. • Males are not naturally better in mathematics than females because they equal and there is no such thing about gender in

					mathematics learning. I will say that a male can do what a female can do and a female can do what a male can do in the learning of mathematics.
2.	Learning through participation	LP_a	Learners' participation in mathematics classroom interactions.	• Actively involved in group work. • Ask questions. • Debate on a solution. • Solve problems on the board.	• I teach my classmates in group work and tasks. I explain to my teacher in mathematics lessons. As such, I want to help peoples who do not understand mathematics and those who think they cannot be good at it. • Yes, I assist my peers in mathematics classwork, especially group classwork. But when I assist my classmates in individual classwork, I do not give them the answer. I only show by explaining to them how to get the answer. • I am very active in my mathematics class because I think it is just my personality. I am a very outgoing person and I really like work and I love writing a lot [smiles]. I contribution to the classroom. When the teacher asks us questions, I answer. I likewise go to the board to solving it for them to see during mathematics lessons.
3.	Learning through support	LS_u	This is evidence by learners' utterances about asking for support from teachers, family members and peers.	• Encouragement. • Assistance with homework. • Working together. • Teachers' responsiveness.	• When I am stuck on a mathematics problem, my teacher helps me out when she is told about it or available. She also advises you on how to get it right. • My brother is really really good at mathematics. He explains to me when I am stuck on a mathematics problem. He explains to me if I let him know of it, or when he finds me struggling, or not happy doing mathematics. • My peers do help me when I need their assistance in

					mathematics because when I do not know a problem and I am confused, I do ask them; they help me a lot like they say do not do that, this is how you do it and so on.

5.4.2 Social fixed mindset

A Social fixed mindset (SFM) provides details about how a fixed mindset played out within the social dimension. The relationship of the social dimension with a fixed mindset in learning constrains learners' knowledge and understanding of SFSCS in the learning process. The social dimension is a process where learners integrate themselves into a community. (society), by interacting with the community. More so, SFM entails the tendencies of learners who hold a fixed mindset not to see the need to integrate themselves into a community (society). They do not seem to interact with the community for integration and so there is an absence of interaction and social participation in the learning process. The possible outcomes of learners with these tendencies are that they would achieve less than their full potentials and, consequently, may not be successful in learning (Appell, 2019; Haimovitz & Dweck, 2017; Dweck, 2000; Popova, 2014; Heyman & Dweck, 1998).

Through an analysis of the 10 learners' interviews data, initially, with open coding to axial coding, the following two categories emerged within SGM: (1) learners' attribute influences learning and (2) non-participation in class. These categories are grouped under social dimension for the reason that they are related to the interaction process, such as participation, communication and cooperation in mathematics learning. These categories are briefly discussed below.

(1) **Learners' attribute influences learning**: It infers that learners' race and gender influence their knowledge and understanding in the learning process. Simply put, effective

learning is influenced by the learners' race and gender, which in turn, impact their [academic] achievement in the learning process (Becares & Priest, 2015). As such, I provide excerpts that demonstrate this category below.

140 Interviewer: Are males naturally better in mathematics than females?

141 Learner: Yes, males are naturally better in mathematics than females; they do say in history that males are smarter than females in mathematics. It does mean that it always going to remain like that. There will not be a time when they will still say that females are smarter than males; and that there will be more females' scientists than males. Always males are smarter. They are blessed with mathematics.

170 Interviewer: Have you ever thought of race in mathematics learning?

171 Learner: Yes, Sir. I have thought of race in mathematics learning.

172 Interviewer: Does being intelligent to learn mathematics have any relationship with your race?

173 Learner: Yes, being intelligent to learn mathematics has a relationship with one's race. But my situation is just unique that mathematics is not my path.

174 Interviewer: Please can you explain why?

175 Learner: Being intelligent to learn mathematics has a relationship with one's race because my daddy is really intelligent in mathematics and equally my mommy is very good. However, it is just unfortunate that I am not good at mathematics as a subject because I am not gifted like my parents.

The learner's excerpts above reveal that her level of capability in a SFSCS and its learning is linked to race and gender. Put simply, having good knowledge of a SFSCS is a function of one's attributes: race and gender. That is, a learner's race and gender influence his/her learning as not every learner can effectively learn a SFSCS – "*Being intelligent to learn mathematics has a relationship with one's race*" (line 173; line 175) and "*Males are naturally better in mathematics than females. Always males are smarter. They are blessed*

with mathematics" (line 141). These are pointers to learners who have developed a fixed mindset toward learning, as they are negative and constrain effective learning of the subject. In this regard, the literature suggests that racism could inform the analysis of a variety of contexts related to SFSCS (Parks & Schmeichel, 2012; Lubienski, 2002). Also, the literature suggests that there is an indication of the influence of gender in the performance of learners in the learning of mathematics, as gender intercedes with female learners' relationships in the learning process of an SFSCS (Radovic, Black, Salas & Williams, 2017; Ali, Bhagawati & Sarmah, 2014; Maliki, Ngban & Ibu, 2009).

(2) **Non-participation in class** – It infers learners' non-involvement or non-contribution in the classroom. In other words, learners do not participate in any activity in the classroom: they do not involve themselves in participation, interactions, communication and cooperation in learning. Interacting in the classroom is a struggle for some learners, which may take different forms: not answering questions, not asking for help, not interacting in group tasks, not even saying anything in the classroom (Shore, 1996). In this light, I provide excerpts that demonstrate this category.

93 Interviewer: Does your mathematics teacher entertain questions from you in the class?

94 Learner: Yes, he does. My mathematics teacher entertains questions in the class, but I do not ask questions in the class. What do I know that I will ask? They will sigh at me [smiles].

229 Interviewer: Do you assist your peers (classmates/other learners) in doing their mathematics assignments (classwork)?

230 Learner: No, what would I help my peers in mathematics classwork with? I am struggling to understand mathematics.

The excerpts above indicate that the learner does not participate socially in class during mathematics learning. She claims that she does not answer questions when asked in the class because of shyness – "*I do not ask questions in the class. What do I know that I will ask?*" (line 94). Furthermore, when the learner was asked if she assists her peer during class activities (line 229), her response was negative – "*No, what would I help my peers in mathematics classwork with?*" (line 230). These dispositions are indications of a learner who has constructed a fixed mindset and they constrain learning, as they are negative. The literature suggests that learners' dispositions like disengagement and non-participation in learning negatively influence learning (Radovic, Black, Salas & Williams, 2017; Claro, Paunesku & Dweck, 2016; Darragh, 2016; Tarhan & Balban, 2014).

It is crucial to note that the above two categories are classified under fixed social mindset, since they are related to the learners' interaction or social process. There are always other people who are involved, directly or indirectly, in the learning process and it is connected to society. More so, the two categories are related to learners who hold a fixed mindset, which have negative consequences for learning and actually constrain it.

Table 13 provides a description, identifying indicators and illustrative examples for each category.

Table 13: Categories and their identifying indicators for social fixed mindset

S/N	Category	Code	Description	Identifying Indicator	Illustrative Example
1.	Learners' attribute influences learning	LA_f	Learners' race and gender influence their mathematics learning.	• Intelligence is related to race. • Males are better.	• Yes, being intelligent to learn mathematics has a relationship with one's race. But my situation is just unique in that mathematics is not my path. • Yes, males are naturally better in mathematics than females; they do say in history that males are smarter than females in mathematics. Always males are smarter. They are blessed with mathematics.
2.	Non-participation in class	LN_o	Learners' utterances that demonstrate their unwillingness to engage or involve in mathematics learning.	• Do not answer questions. • Scared to ask questions. • Do not say anything. • Do nothing. • Not involving.	• I will be shy maybe when I give a wrong answer, the class will look at me. So, I do not answer. • To that effect, I stop doing it. That is the reason I do not say or do anything in the mathematics lessons; even in the group tasks, I do not like to speak as there are learners in the group who are smart in mathematics. They should be the ones doing or showing us the way to follow in the group tasks. • My mathematics teacher entertains questions in the class, but I do not ask. What do I know that I will ask? They will sigh at me [smiles].

Table 14 displays a summary of the categories here – social growth mindset and social fixed mindset.

Table 14: Categories of social growth and fixed mindsets

Social Growth Mindset	Social Fixed Mindset
Learners' attribute inconsequentiality in learning	Learners' attribute influences learning
Learning through participation	Non-participation in class
Learning through support	

Table 14 depicts two categories and their respective identifying indicators. The social growth mindset (SGM) and the fixed social mindset (FSM) have consequences for SFSCS and its learning. The SGM affords SFSCS and its learning, i.e. SGM positively influences learners' participation, interactions, communication and cooperation in the learning process. However, SFM constrains SFSCS and its learning: SFM negatively influences learners' participation, interactions, communication and cooperation in the learning process (Boaler, 2016; Yeager & Dweck, 2012; Illeris, 2009; Maliki, Ngban & Ibu, 2009; Dweck, 2006a).

5.5 Summary

In this chapter, I developed the analytical framework of this present study. As such, I put together the theoretical field (theories that underpin the study) and the empirical field (collected data) of this study to develop the analytical framework. This is a key contribution in the field.

Table 15 presents the summary of the analytical framework showing all the categories and codes that emerged across the three dimensions of learning and the two types of mindsets.

Table 15: Analytical framework for the study

Dimensions	Growth Mindset	Fixed mindset
Cognitive	• Learning not innate • Errors as resource in learning • Learning mathematics as valuable	• Born smart in learning • Errors as a setback in learning • Learning mathematics is abstract
Emotional	• Excited when learning • Learning through practice and perseverance • Learning with confidence • Feeling competent to learn	• Bored when learning • Laissez-faire attitude towards learning • Learning with uncertainty • Learning with inadequateness
Social	• Learners' attribute inconsequentiality in learning • Learning through participation • Learning through support	• Learners' attribute influences learning • Non-participation in class

Table 15 depicts the three dimensions with their respective categories classified under the growth mindset and fixed mindset.

I now proceed to the next chapter learners' mindsets and their influence on learning, where I used the analytical framework to interpret learners' mindsets and their influence on mathematics learning.

CHAPTER 6

LEARNERS' MINDSETS AND THEIR INFLUENCE ON LEARNING

6.1 Introduction

In Chapter 5, I discussed how I conceptualised mindsets within the Illeris's three dimensions of learning, which constituted the analytical framework for this study. This was done by bringing together the theoretical field and empirical field. The concern of this chapter is to present findings and discussions on learners' mindset and its influence on learning through the analysis of ten learners' interviews. The findings of the ten learners are presented according to two broad categories: low achievers and high achievers. As indicated in Chapter 4, the classification of low and high achievers was done by their teachers in relation to the track records of the learners' performance over a number of years. Thereafter, a case of each learner was presented with further categorisation into two crucial categories: growth mindset and fixed mindset under each of the dimensions (themes): cognitive dimension, emotional dimension and social dimension. Finally, summaries of findings across the low achievers and the high achievers are presented and the synthesis across the ten case studies is equally presented.

6.2 Low achievers' learners

As mentioned in Chapter 4, race, gender and achievement in a strongly framed and strongly classified subject (SFSCS), like mathematics, were the main criteria that were used in the selection of the ten learners. As such, five low achieving and five high achieving learners were selected and participated in this study.

In line with the above, the five learners who are in the category of low achievers are Learner 2 (Thapelo), Learner 4 (Lebogang), Learner 5 (Mpho), Learner 6 (Lisa) and Learner 10 (Charles). I, therefore, examine each of the learner's interviews in detail using the analytical framework presented in Chapter 5.

A case study of each of the five learners is given below. I present findings for each of the five learners according to Illeris's three dimensions of learning and the Dweck's two types of mindsets, as well as discuss the influence of each on the learning of subjects like mathematics.

6.2.1 A case of Thapelo

Thapelo is a Black male who is a low achiever in mathematics. Figure 8 and Table 16 present summaries of the findings of the interview with Thapelo.

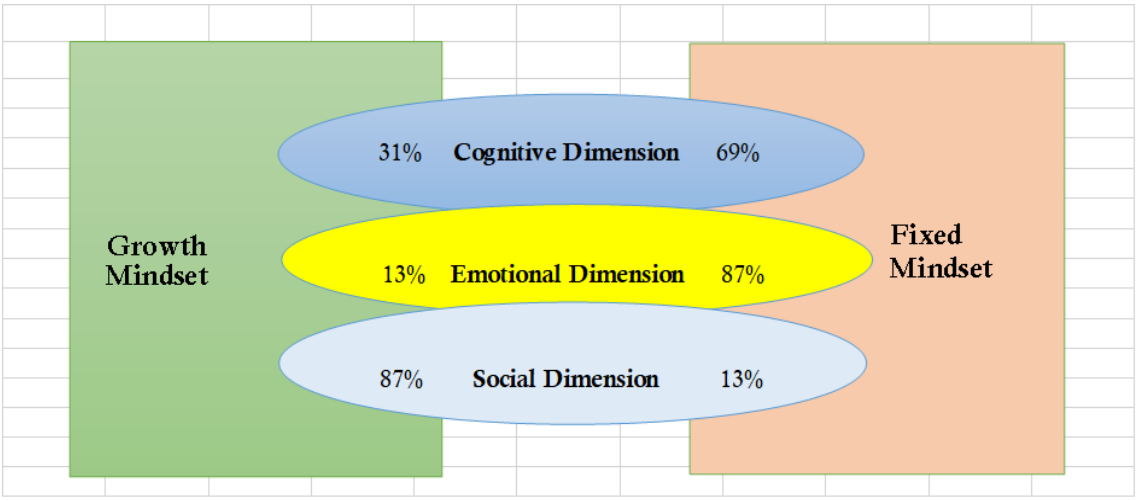


Figure 8: Thapelo profiling of mindsets within Illeris's dimensions of learning

Figure 8 shows Thapelo's frequencies of responses in terms of the two distinct kinds of mindsets (growth mindset and fixed mindset), represented in the two rectangles with three oval shapes representing the three dimensions (cognitive, emotional and social) mapping

from the growth mindset to the fixed mindset. The oval shapes overlap each other, indicating that the three dimensions work together all the time: 31% of the responses is within the cognitive growth mindset; 69% within the cognitive fixed mindset at the cognitive level 13% within the emotional growth mindset and 87% within the emotional fixed mindset, at the emotional level. Also, 13% of the responses is within the social growth mindset and 87% is within the social fixed mindset at the social level. Collectively, Thapelo's utterances indicated predominance in the fixed mindset across the three dimensions of learning.

Table 16 presents more details of Thapelo's case by itemising the categories with their corresponding frequencies within their dimensions respectively, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 16: Summary of Thapelo categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	5/16 (31% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	11/16 (69% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	2/16 (13% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	14/16 (87% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	13/15 (87% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	2/15 (13% of all categories in the social dimension fixed mindset)

On the cognitive level, Table 16 indicates that Thapelo's responses were predominantly cognitive fixed mindset, constituting 69% of all incidents, with the most frequent (9 incidents) responses indicating a belief that mathematics intelligent people are born with it, rather than acquiring it through learning, hard work and perseverance. Within a cognitive fixed mindset as well, in 2 incidents, Thapelo perceives errors as a setback in learning. However, it can also

be noted that Thapelo in 3 incidents values mathematics and sees mistakes as a resource for learning in 2 incidents. These two categories are within the cognitive growth mindset.

Within the emotional dimension, Thapelo's responses were also predominantly emotional fixed mindset (87%), perceptions on learning with inadequacies (6 incidents), learning with uncertainty (4 incidents) and some laissez-faire attitude towards learning of mathematics (4 incidents). However, Thapelo also acknowledges, in 2 incidents, that mathematics learning requires practice and perseverance. This category is within the emotional growth mindset.

In the social dimension, Thapelo's responses were predominantly social growth mindset (87%), believing that learning mathematics requires support (10 incidents). Within the social growth mindset as well, in 3 incidents, Thapelo believes that learners' attributes are inconsequential in learning mathematics. However, he also indicated his feelings of non-participation in class (2 incidents). This category is within the social fixed mindset.

Overall, Thapelo's responses during the interview indicated predominance in fixed mindset within the cognitive and emotional dimensions, but a growth mindset within the social dimension. In the next section, I provide a qualitative analysis of selected predominant excerpts within the three dimensions of learning.

6.2.1.1 Thapelo's cognitive fixed mindset

As indicated in Table 16, Thapelo's responses in the interview regarding the cognitive dimension were predominantly of a fixed mindset. One of the categories demonstrated here was that Thapelo showed a strong belief that some learners are born smart in learning mathematics - that mathematics learning is innate (inborn). This is classified within the

cognitive fixed mindset. Below, I provide evidence from the interview excerpts to support this point.

Interviewer:	Can you tell me about your beliefs about mathematics?
Thapelo:	I find mathematics very very difficult; and mathematics is not my path.
Interviewer:	Please explain how.
Thapelo:	I am not committed to mathematics because mathematics is not my path, not my way of life and not in existence because of me as well.
Interviewer:	Must you have to be a 'special' person in order to be good at mathematics?
Thapelo:	Yes, you have to be a 'special' person in order to be good at mathematics.
Interviewer:	Explain, please.
Thapelo:	Like I said, you have to be a 'mathematics person' in order to be good in mathematics because if you are knowledgeable in mathematics. I think 'mathematics person' is the same as a 'special' person here.

The excerpts above infer that Thapelo strongly believes that some learners are born with the intelligence to effectively learn mathematics. They possess special knowledge and understanding of mathematics from God. In other words, being knowledgeable in mathematics and its learning is inborn (innate). These beliefs are associated with a learner who holds a fixed mindset and may have consequences for the learning of the subject. Literature suggests that this constrains success in learning the subjects, as some learners believe that intelligence and smartness are innate and cannot be learned and there is nothing anyone can do to change these central personalities (Haimovitz & Dweck, 2017; Zhang, Kuusisto & Tirri, 2017; Boaler, 2013; Dweck, 2013b; Dweck, 2006a). This is evident in how a learner engages with his/her learning. Mindsets have a vital role in learning, as a learner's mindset affects his/her learning. One may argue that Thapelo's low achievement in mathematics may have a link with his mindset.

6.2.1.2 Thapelo's emotional fixed mindset

As indicated in Table 16, Thapelo's responses in the interview regarding the emotional dimension were predominantly that of a fixed mindset. One of the categories demonstrated here was Thapelo's attitude regarding his competence in learning mathematics. This is classified within the emotional fixed mindset. Below, I provide evidence from the interview excerpts to support this point.

Interviewer:	Do you feel competent to do mathematics?
Thapelo:	No ooo, I do not feel competent to do mathematics.
Interviewer:	Do you pass mathematics examinations easily?
Thapelo:	No, I do not pass mathematics examinations easily. I guess I am not competent enough.
Interviewer:	Do you think that you are good at mathematics?
Thapelo:	No ooo, I am not good at mathematics.
Interviewer:	Why?
Thapelo:	I am not good at mathematics given that I failed my grade last year because of mathematics since I am not competent [smiles].

The above excerpts by Thapelo infer that he perceived himself as not competent in learning mathematics well, so he lacks self-competence to do mathematics effectively. What is interesting is the fact that Thapelo was so open to express his lack of competence to learn mathematics. This is an indication of a learner who holds a fixed mindset and it constrains effective learning of the subject. Literature suggests that every learner must be competent to study mathematics. Invariably, a learner who is not competent in learning mathematics will not be able to learn it (mathematics) effectively. This has been shown to have a negative influence on learning mathematics (Bansilal, Webb & James, 2015; Darragh, 2013). Again,

one may argue that Thapelo's perception of himself as incompetent to learn mathematics may have an influence on his achievement in the subject.

6.2.1.3 Thapelo's social growth mindset

As indicated in Table 16, Thapelo's responses in the interview regarding the social dimension were growth mindset. One of the categories demonstrated here was Thapelo's views on the social support that he gets whenever he needs, or seeks, support from his teacher, family members and peers. This is classified within the social growth mindset. Below, I provide evidence from the interview excerpts to support this point.

Interviewer:	How would you describe your relationship with the mathematics teacher?
Thapelo:	My mathematics teacher is very helpful, happy and friendly. If you told him (teacher) something, he does not shout at you, he is always ready to teach you any time.
Interviewer:	Do your peers (classmates/other learners) help you in any way when you need assistance in mathematics learning?
Thapelo:	Some of my classmates help me when I need their assistance in mathematics learning.
Interviewer:	Explain how.
Thapelo:	Some of my classmates are really clever, so they understand the work. When I ask them for help, they do help me.
Interviewer:	Do your peers (classmates/other learners) assist you in doing your mathematics assignments (classwork)?
Thapelo:	Yes, my peers assist me in mathematics if we are working in a group, we do assist each other. That is the essence of group work.
Interviewer:	Do any of your family members (siblings, parents, or guidance) contribute to your mathematics learning?
Thapelo:	Yes, my family members contribute to my mathematics learning.
Interviewer:	Explain how, please.

Thapelo: My family members contribute to my mathematics learning by always teaching and pushing me to study, do better and pass at the end of the year to help me to go to the next grade.

Interviewer: Do any of your family members (siblings, parents, or guidance) assist you in doing your mathematics assignments (homework)?

Thapelo: Yes, my family members assist me with my mathematics homework.

Interviewer: How has what they (other learners, teachers, or family members) said made you think about mathematics?

Thapelo: Well, the way my brother and teacher say about mathematics is pushing me to do my work and think good about mathematics at the end of the day [smiles].

Excerpts from the interview with Thapelo indicate that he values and seeks support from different individuals to learn mathematics. This comes from parents (family members), as well as his peers and mathematics teachers at school. These are associated with a growth mindset, because there is potential to afford learning. When learners appreciate support there is potential for some learning to occur (Martin, 2006; Nasir & Hand, 2006; Reyes & Stanic, 1998).

It is worth noting that Thapelo's profile indicated a fixed mindset in both cognitive and emotional dimensions. Interestingly, though, it was a growth mindset in the social dimension and, more specifically, at the level of 'support' to learn. Schratz (2006) proposes four states of awareness that individuals undergo when new innovations are introduced into the school system to document changes in practice. One of these states of awareness he termed 'conscious incompetence' – a situation where an individual recognises limitations of his/her knowledge which set that individual at the level of insecurity. Abdulhamid (2016) found that individuals at this state look out for support to fill in the knowledge gap. It is evident that Thapelo acknowledges his level of incompetence in the learning of mathematics. One may argue that it is this acknowledgement that makes Thapelo develop a growth mindset at the level of social dimension.

6.2.2 A case of Lebogang

Lebogang is a Black female who is a low achiever in mathematics learning. Figure 9 and Table 17 present summaries of the findings of the interview with Lebogang.

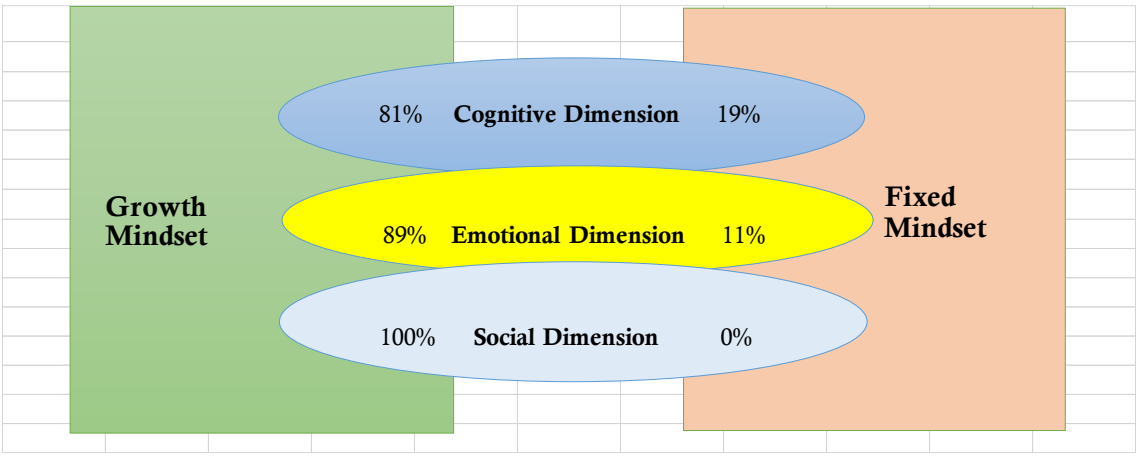


Figure 9: Lebogang profiling of mindsets within Illeris's dimensions of learning

Figure 9 shows Lebogang's frequencies of responses in terms of the two distinct kinds of mindsets (growth and fixed mindsets) represented in the two rectangles, with three oval shapes representing the three dimensions (cognitive, emotional and social) mapping from the growth mindset to the fixed mindset. Furthermore, the oval shapes overlap each other, indicating that the three dimensions work together all the time, with 81% of the responses within the cognitive growth mindset, 89% within the emotional growth mindset and 100% of the responses within the social growth mindset.

Table 17 provides more details of Lebogang's case by itemising the categories with their corresponding frequencies within their dimensions respectively, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 17: Summary of Lebogang categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	13/16 (81% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	3/16 (19% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	17/19 (89% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	2/19 (11% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	16/16 (100% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	0/16 (0% of all categories in the social dimension are fixed mindset)

On the cognitive level, Table 17 indicated that Lebogang's responses were predominantly cognitive growth mindset, constituting 81% of all incidents with the most frequent responses that she views making mistakes as a resource in mathematics learning (6 incidents). More so, Lebogang believes that learning mathematics is valuable (5 incidents). She also believes, in 2 incidents, that learning mathematics is not inborn (innate). On the contrary, it can be noted in

3 incidents that Lebogang views mathematics learning as not useful. This category is within the cognitive fixed mindset.

Within the emotional dimension, Lebogang's responses were predominantly emotional growth mindset (89%), believing in learning through practice and perseverance (8 incidents), excited when learning (4 incidents), learning with confidence (4 incidents) and learning with competence (1 incident). In contrast, Lebogang acknowledges, in 2 incidents some of her laissez-faire attitudes towards learning mathematics. This category is within the emotional fixed mindset.

On the social dimension, Lebogang's responses were completely social growth mindset (100%), believing that learning mathematics requires support (11 incidents), learners' attributes are inconsequential in learning mathematics (4 incidents) and participation is critical in learning mathematics (1 incident).

Overall, Lebogang's responses during the interview indicated a predominance in growth mindset within cognitive, emotional and social dimensions. It is interesting to note that Lebogang's profiling indicated growth mindsets in all the three dimensions of learning, but she is classified as a low achiever. This demonstrated the complexity of the concept of mindset. To unpack this complexity and to find a possible explanation for this pattern of mindset, I provide a qualitative analysis of selected predominant categories within the three dimensions of learning.

6.2.2.1 Lebogang's cognitive growth mindset

As indicated in Table 17, Lebogang's responses in the interview concerning the cognitive dimension were predominantly a growth mindset. One of the categories established here was

that Lebogang viewed making mistakes as a resource in learning mathematics. This is grouped within the cognitive growth mindset. Below, I provide evidence from the interview extracts to support this point.

Interviewer: Does making mistakes help?

Lebogang: Making mistakes helps in mathematics.

Interviewer: Why? Please explain.

Lebogang: Making mistakes helps in mathematics because you learn from your mistakes.

Interviewer: What does making a mistake means to you in mathematics?

Lebogang: Making mistakes in mathematics helps me to know how to do it better or handle similar problems in the future.

The above extracts from the interview with Lebogang show that making mistakes in learning mathematics is beneficial to her, as it enables her to develop (understand it better) and tackle similar and related mathematics problems. These are evident in a learner who holds a growth mindset and they enhance learning of the subject. Literature suggests that making mistakes in learning is a vital avenue for effective learning and development. More so, mistakes allow one's brain to grow (Boaler, 2013). However, we do not know the extent to which Lebogang utilises mistakes as resource for learning.

6.2.2.2 Lebogang's emotional growth mindset

As indicated in Table 17, Lebogang's responses in the interview concerning the emotional dimension were predominantly a growth mindset. One of the categories established here was Lebogang's responses to learning mathematics through practice and perseverance. This is grouped within the emotional growth mindset. Below, I provide evidence from the interview extracts to support this point.

Interviewer: Do you read and practice mathematics?

Lebogang: Yes, I read and practice mathematics. I read the rules and then practice them.

Interviewer: What do you often say about mathematics?

Lebogang: 'Never quit on mathematics', that is what I do say about mathematics.

Interviewer: Why?

Lebogang: I do say 'never quit on mathematics' because it is a tricky subject. If you persist you will always get it right.

Interviewer: When you are stuck on a mathematics problem or when you get something wrong, what do you do or say?

Lebogang: When I am stuck on a mathematics problem or when I get something wrong, I need someone to talk to; and I look for someone to talk to about the problem, who can explain it to me. Maybe I can do better because I cannot just quit.

The above extracts show that Lebogang reads and practices mathematics regularly to enable her to have good and more knowledge of the subject. More so, she does not quit when she is combated with challenges when solving mathematics problems. These are associated with a learner who holds a growth mindset and they afford success in the learning of the subject. From the literature, a learner with a growth mindset grows his/her abilities more through practice and perseverance in mathematics learning (Appell, 2019; Haimovitz & Dweck, 2017).

6.2.2.3 Lebogang's social growth mindset

As indicated in Table 17, Lebogang's responses in the interview concerning the social dimension were completely a growth mindset. One of the categories established here was Lebogang's views on the social support that she gets whenever she needs or seeks support from her teacher, family members and peers. This is grouped within the social growth mindset. Below, I provide evidence from the interview extracts to support this point.

Interviewer: Do your peers (classmates/other learners) help you in anyways help you when you need assistance in mathematics learning?

Lebogang: Yes, my peers are very helpful when I need their assistance in mathematics.

Interviewer: Explain how.

Lebogang: My peers are very helpful when I need their assistance in mathematics. Not everyone understands everything and there are some things I do not understand while some learners do, so I go to those learners who understand properly what I do not understand and they explain it to me.

Interviewer: Do any of your family members (siblings, parents, or guidance) contribute to your mathematics learning?

Lebogang: Yes, my parents and uncle contribute to my mathematics learning because I am an only child.

Interviewer: Explain how, please.

Lebogang: My uncle has a lot of experience, so he knows when and how to help me.

Interviewer: Do any of your family members (siblings, parents, or guidance) assist you in doing your mathematics assignments (homework)?

Lebogang: Yes, when I need help in mathematics, my family members assist me.

Interviewer: What about your teacher?

Lebogang: My teacher makes sure that you keep asking him when you get stuck.

Interviewer: What about your family members?

Lebogang: When I am stuck on a mathematics problem or when I get something wrong [laughs] my parents help me. If maybe my parents cannot help me, they find someone who can help me out with the problem.

The extracts from the interview with Lebogang show that she gets the amount of support she needs in mathematics and its learning at home from her parents (family members), as well as the support she needs from her peers and mathematics teacher at school. These are associated with a learner who has constructed a growth mindset and they afford learning of the subject. The literature suggests that, when a learner gets the support that he/she needs in mathematics learning, it enhances him/her in the learning of the subject (Martin, 2006; Nasir & Hand, 2006).

Lebogang provided a very exceptional profile of mindset across the three dimensions of learning. One should expect a fixed mindset to be associated with a low achiever and a

growth mindset associated with a high achiever. It will be interesting to follow up with Lebogang to understand how she participated in class and to analyse how she responds to class assessments.

6.2.3 A case of Mpho

Mpho is a Black female, who is a low achiever in mathematics learning. Figure 10 and Table 18 present summaries of the findings of the interview with Mpho.

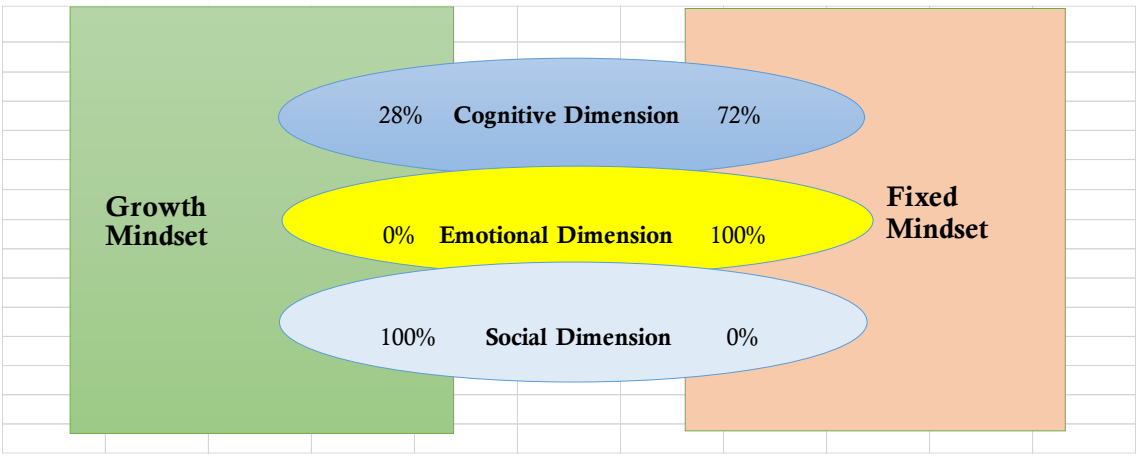


Figure 10: Mpho profile of mindsets within Illeris's dimensions of learning

Figure 10 shows Mpho's frequencies of responses, with 28% of the responses within the cognitive growth mindset; 19% within the cognitive fixed mindset, at the cognitive level; 0% within the emotional growth mindset; 100% within the emotional fixed mindset, at the emotional level; 100% within the social growth mindset; and 0% within the social fixed mindset, at the social level.

Below is a table presenting further details of Mpho's case, itemised according to the categories with their corresponding frequencies within their respective dimensions, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 18: Summary of Mpho categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	5/18 (28% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	13/18 (72% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	0/18 (0% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	18/18 (100% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	15/15 (100% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	0/15 (0% of all categories in the social dimension are fixed mindset)

On the cognitive level, Table 18 indicates that Mpho's responses were predominantly cognitive fixed mindset, constituting 72% of all incidents, with the most frequent (9 incidents) indicating a belief that mathematics intelligent people are born with it, rather than acquiring it through learning, hard work and perseverance. Within the cognitive fixed mindset as well, ion 4 incidents, Mpho perceives errors as a setback in learning. On the other hand, it can be noted

that, in 3 incidents, Mpho values mathematics and sees mistakes as a resource for learning in 2 incidents. These two categories are within the cognitive growth mindset.

Within the emotional dimension, Mpho's responses were completely emotional fixed mindset (100%), with perceptions of her laissez-faire attitudes towards learning of mathematics (8 incidents), learning with uncertainty (6 incidents) and learning with inadequacies (1 incident).

On the social dimension, Mpho's responses were completely social growth mindset (100%), believing that learning mathematics requires support (10 incidents), learners' attributes are inconsequential in learning mathematics (3 incidents) and participation is critical in learning mathematics (2 incidents).

Overall, Mpho's responses during the interview indicated predominance in fixed mindset, within the cognitive dimension; complete fixed mindset, within the emotional dimension; and complete growth mindset, within the social dimension. In the next section, I provide a qualitative analysis of selected predominant abstracts within the three dimensions of learning.

6.2.3.1 Mpho's cognitive fixed mindset

As indicated in Table 18, Mpho's responses in the interview relating to the cognitive dimension were predominantly a fixed mindset. One of the categories demonstrated here was that Mpho displayed a strong belief that some learners are born smart in learning mathematics, that mathematics learning is innate (inborn). This is classified within the cognitive fixed mindset. Abstracts below exemplify this finding.

Interviewer: Can you tell me about your beliefs about mathematics?

Mpho: I will say that mathematics is not for all and it is very complicated.

Interviewer: Please explain why.

Mpho: Mathematics makes you feel as if you are not smart at all. Emmm mathematics is just difficult. I am not a mathematics person. I am not created to be good at mathematics and it is not created for me.

Interviewer: Does doing difficult problems help?

Mpho: Yes, Sir. Doing difficult problems in mathematics help. However, difficult problems show my weakness, especially when I make mistakes eish. So, it makes me sad. I do not like it. At times I ask myself why I attempted the difficult problem(s) when I know full well that mathematics is not my path.

The abstracts above display that Mpho strongly believes that some learners are born with the intelligence to learn mathematics effectively: some learners are 'specially' created by God to be good at mathematics and its learning. In other words, being good at mathematics and its learning is inborn (innate). These beliefs point to a learner who has constructed a fixed mindset and may have consequences for mathematics learning, as the literature suggests that these beliefs deter effective learning (Haimovitz & Dweck, 2017; Boaler, 2013). This is evident in how a learner engages with his/her learning. Mindsets have a vital role in learning, as a learner's mindset affects his/her learning.

6.2.3.2 Mpho's emotional fixed mindset

As indicated in Table 18, Mpho's responses in the interview relating to the emotional dimension were predominantly a fixed mindset. One of the categories demonstrated here was Mpho's laissez-faire attitude towards mathematics learning. This is classified within the emotional fixed mindset. Extracts below exemplify this finding.

Interviewer: How will you describe yourself in the learning of mathematics?

Mpho: I see myself in the learning of mathematics like emmm struggling to know the stuff. Though I rarely fail mathematics, but it is not my way. I just have to do it because it is a must for me. If I have my way, I would drop mathematics [smile], but I cannot drop it.

Interviewer: When you are stuck on a mathematics problem or when you get something wrong, what do you do or say?

Mpho: When I am stuck on a mathematics problem, I get angry and leave it. Anyways, I do console myself with the saying that I am not created to be smart in mathematics. Just like, I am not designed by God to be good at mathematics.

The above extracts display Mpho's disposition towards a lack of determination and perseverance in learning mathematics. Mpho does not persist when stuck in a mathematics problem, she quits. These dispositions are indications of a learner who has developed a fixed mindset and they constrain learning, which leads to failure in the subject, as the literature suggests that a learner who has developed a fixed mindset, avoids or quits on challenges in mathematics learning (Haimovitz & Dweck, 2017; Boaler, 2013).

6.2.3.3 Mpho's social growth mindset

As indicated in Table 18, Mpho's responses in the interview concerning the social dimension were completely a growth mindset. One of the categories demonstrated here was Mpho's views on the social support that she gets whenever she needs or seeks support from her teacher, family members and peers. This is classified within the social growth mindset. Abstracts below exemplify this finding.

Interviewer: Do your peers (classmates/other learners) help you in any way when you need assistance in mathematics learning?

Mpho: Yes, Sir. My peers help me when I need their assistance in mathematics learning.

Interviewer: Explain how.

Mpho: When I need the assistance of my peers, they show me the steps and write them on paper. They (my peers) ask me if I understand. If no, they repeat it.

Interviewer: Do your peers (classmates/other learners) assist you in doing your mathematics assignments (classwork)?

Mpho: Yes, my peers assist me in mathematics group classwork sometimes.

Interviewer: Do any of your family members (siblings, parents, or guidance) contribute to your mathematics learning?

Mpho: Yes, most of my family members help in my mathematics learning.

Interviewer: Explain how, please.

Mpho: Like my elder brother who is in the university helps me in mathematics learning whenever he is back from school (holidays). He teaches me how it is done. He says you must repeat it and repeat it until you get it. However, I do not have the patience and strength to continue to repeat mathematics problem(s) especially when I know am not good at it and probably not get it right still.

Interviewer: Do any of your family members (siblings, parents, or guidance) assist you in doing your mathematics assignments (homework)?

Mpho: Yes, my brother does assist me with my mathematics homework when he is around.

The above extracts from the interview with Mpho display that she gets the amount of support she needs in mathematics and its learning at home from her parents (family members) and from her peers and mathematics teacher at school. These are associated with a learner who holds a growth mindset and they afford learning of the subject. The literature suggests that when a learner gets the support that he/she needs in mathematics learning, it enhances the learning of the subject (Nasir & Hand, 2006; Reyes & Stanic, 1998).

6.2.4 A case of Lisa

Lisa is a White female who is a low achiever in mathematics learning. Figure 11 and Table 19 present summaries of the findings of the interview with Lisa.

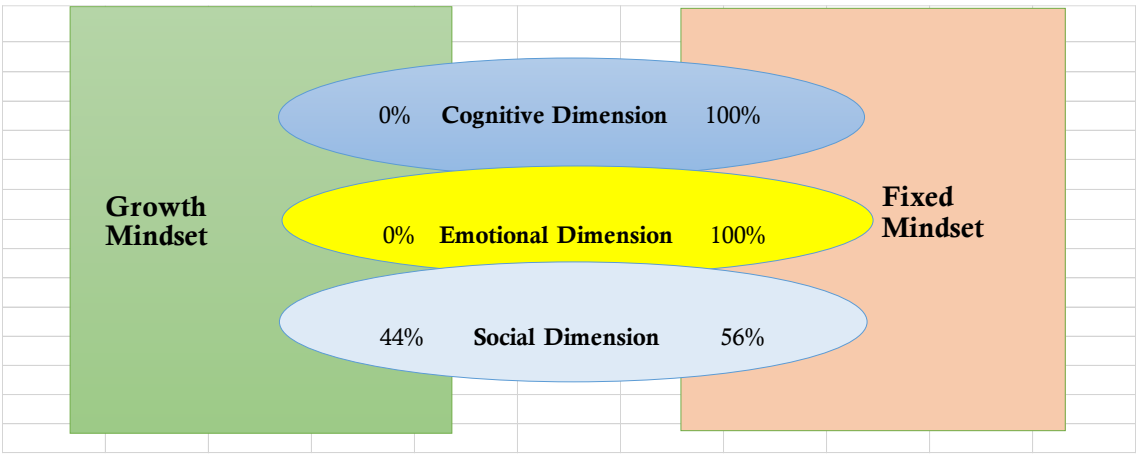


Figure 11: Lisa profile of mindsets within Illeris's dimensions of learning

Figure 11 shows Lisa's frequencies of responses, 0% of which are within the cognitive growth mindset; 100% within the cognitive fixed mindset, at the cognitive level; 0% within the emotional growth mindset; 100% within the emotional fixed mindset, at the emotional level; 44% responses within the social growth mindset; and 56% within the social fixed mindset, at the social level.

Table 19: Summary of Lisa categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	0/28 (0% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	28/28 (100% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	0/27 (0% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	27/27 (100% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	4/9 (44% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	5/9 (56% of all categories in the social dimension are fixed mindset)

On the cognitive level, Table 19 indicates that Lisa's responses were completely cognitive fixed mindset (100%), with the most frequent (18 incidents) indicating that a belief that mathematics intelligent people are born with it, rather than acquiring it through learning, hard work and perseverance. Also within the cognitive fixed mindset, in 6 incidents, Lisa perceives that learning mathematics is not useful and she perceives errors as a setback in learning mathematics in 4 incidents.

Within the emotional dimension, Lisa's responses were completely emotional fixed mindset (100%). She reveals her laissez-faire attitudes towards learning mathematics (8 incidents), boredom when learning mathematics (7 incidents), learning with uncertainty (5 incidents) and learning with inadequacies (1 incident).

In the social dimension, Lisa's responses were more social fixed mindset (56%), believing that learners' attributes influence their learning mathematics (3 incidents) and seemed not to see the need for social participation in class, rather non-participation in class when learning mathematics (2 incidents). Conversely, of all incidents, the most frequent (4 incidents) responses of the social dimension are about learning mathematics through support. This category is within the social growth mindset.

Overall, Lisa's responses during the interview indicated a completely fixed mindset within cognitive and emotional dimensions, as well as a more fixed mindset within social dimensions. In the next section, I provide a qualitative analysis of selected predominant assertions within the three dimensions of learning.

6.2.4.1 Lisa's cognitive fixed mindset

As indicated in Table 19, Lisa's responses in the interview relating to the cognitive dimension were completely a fixed mindset. One of the categories illustrated here was that she depicted a strong belief that some learners are born smart in learning mathematics - that is mathematics learning is innate (inborn). This is grouped within the cognitive fixed mindset. Assertions below demonstrate this finding.

Interviewer:	Must you have to be a 'special' person in order to be good in mathematics?
Lisa:	Yes, you have to be a 'special' person in order to be good at mathematics.

Interviewer: Explain.

Lisa: Like I said, emmm you have to be a 'special' person in order to be good in mathematics because it is because I am not special in mathematics, hence I am struggling to understand it. However, the special ones do not struggle like I do to learn mathematics effectively.

Interviewer: Can you tell me about your beliefs about mathematics?

Lisa: I will say that mathematics is not for all and it is very complicated.

Interviewer: Please explain why?

Lisa: Mathematics makes you feel as if you are not smart at all. Emmm mathematics is just difficult. I am not a mathematics person. I am not created to be good at mathematics and it is not created for me.

Interviewer: Can you tell me about your interest in mathematics?

Lisa: My interest in mathematics is that emmm I need to know mathematics because my brother is really good at mathematics. I am not good at mathematics like my brother. My brother always tells me that I need to put my mind on it, but when I try to do that, it gets difficult. Eish, I think mathematics is not for me and I am not a mathematics person.

Interviewer: What do you often say about mathematics?

Lisa: Mathematics is very challenging. Mathematics is not for all, not for the weaklings, but the strong [smiles].

Interviewer: How has what they (other learners, teachers, or family members) said made you think about mathematics?

Lisa: What others have said about mathematics has not altered or improves anything in my knowing mathematics because I am already less in mathematics learning.

The assertions above depict that Lisa strongly believes that some learners are born with the intelligence to effectively learn mathematics, that is some learners are uniquely created by God to be special and good at mathematics and its learning. In other words, being good at mathematics and its learning is inborn (innate). These beliefs point to a learner who has constructed a fixed mindset and may have consequences for the learning as the literature suggests that the beliefs prevent effective learning of the subject (Zhang, Kuusisto & Tirri,

2017; Dweck, 2006a). This is evident in how a learner engages with his/her learning. Mindsets have a vital role in learning, as a learner's mindset affects his/her learning.

6.2.4.2 Lisa's emotional fixed mindset

As indicated in Table 19, Lisa's responses in the interview, relating to the emotional dimension, were completely a fixed mindset as well. One of the categories illustrated here was Lisa's laissez-faire attitude towards mathematics learning. This is grouped within the emotional fixed mindset. Assertions below demonstrate this finding.

Interviewer:	When you are stuck on a mathematics problem or when you get something wrong, what do you do or say?
Lisa:	I am always cross when I am stuck on a mathematics problem. I take a break and do not go back to it most times because I will still get stuck if I go back to it. However, I do not bother much. All I need at the moment is just to manage a pass and move forward.
Interviewer:	What does your teacher do?
Lisa:	When we get stuck on a mathematics problem, most of us leave it. The teacher will not know.
Interviewer:	What about your family members?
Lisa:	When I am stuck on a mathematics problem, emmm I do not go to my parents because they know I will not seek help because I am not interested.
Interviewer:	Do you do your assignments, that is classwork and homework?
Lisa:	Not all my mathematics assignments.

The above assertions depict Lisa's disposition of lack of determination and perseverance in learning mathematics. More so, the learner does not persist when stuck in a mathematics problem, she quits. These are indications of a learner who holds a fixed mindset. A learner who is exhibiting a fixed mindset always perceives efforts as pointless in mathematics and its learning. These dispositions constrain learning and lead to failure in the subject. The literature suggests that a learner who holds a fixed mindset does not put effort into, or persist

in, mathematics learning, but, rather, avoids and/or quits challenges in learning the subject (Haimovitz & Dweck, 2017; Boaler, 2013).

6.2.4.3 Lisa's social growth mindset

As indicated in Table 19, Lisa's responses in the interview concerning the social dimension were more fixed mindset. One of the categories illustrated in the social dimension was Lisa's views on the social support that she gets whenever she needs or seeks support from her teacher, family members and peers. This is grouped within the social growth mindset. Assertions below demonstrate this finding.

Interviewer:	What do you often say about mathematics?
Lisa:	Mathematics is very challenging. Mathematics is not for all, not for the weaklings, but the strong [smiles].
Interviewer:	What about other learners?
Lisa:	Some learners' say they are enjoying mathematics, while some learners say it is very difficult.
Interviewer:	What about your teacher?
Lisa:	My mathematics teacher says we should always think before we ink in mathematics. But nothing for me to think and ink about mathematics.
Interviewer:	What about your family members?
Lisa:	My family members do say mathematics is what one builds up with and he/she gets to know from the start to enjoy it.
Interviewer:	Do any of your family members (siblings, parents, or guidance) assist you in doing your mathematics assignments (homework)?
Lisa:	They (family members) do my mathematics homework. They only help me, so that I have something to give to my teacher when I get to the school the following day without understanding what they have done for me [smiles].
Interviewer:	Can you tell me about your interest in mathematics?
Lisa:	My interest in mathematics is that emmm I need to know mathematics because my brother is really good at mathematics. I am not good at

> mathematics like my brother. My brother always tells me that I need to put my mind on it.

Lisa's assertions above depict she gets the amount of support she needs in mathematics and its learning at home from her parents (family members), as well as the support she needs from her peers and mathematics teacher at school. These are associated with a learner who holds a growth mindset, because they afford learning. The literature suggests that when a learner is supported with his/her needs in mathematics learning, it enhances effective learning of the subject (Martin, 2006; Reyes & Stanic, 1998).

It is crucial to note here that Lisa has a unique profile that fits the expectations, that is, a fixed mindset being associated with low achievers.

6.2.5 A case of Charles

Charles is a White male who is a low achiever in mathematics learning. Figure 12 and Table 20 present summaries of the findings of the interview with Charles.

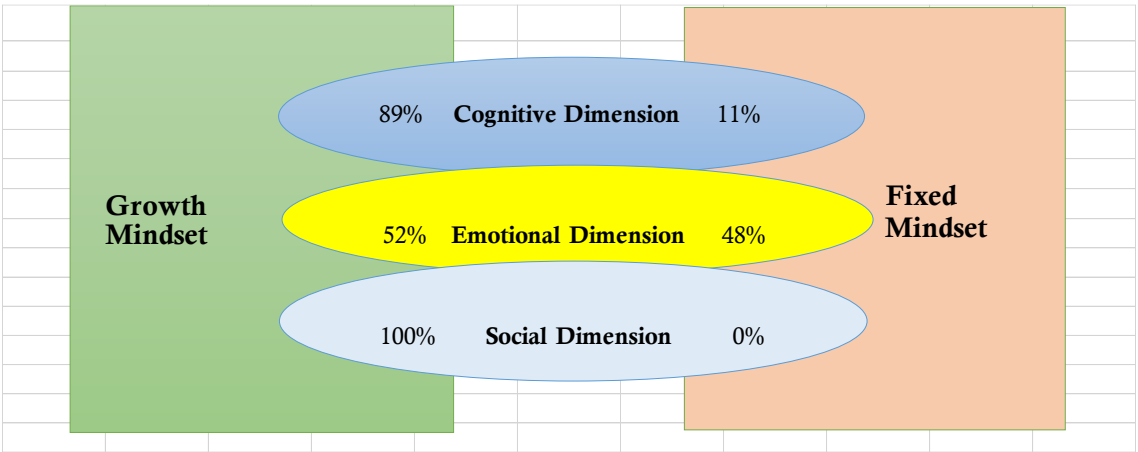


Figure 12: Charles profile of mindsets within Illeris's dimensions of learning

Figure 12 shows Charles's frequencies of responses in terms of the two distinct kinds of mindsets (growth mindset and fixed mindset) represented in the two rectangles with three

oval shapes representing the three dimensions (cognitive, emotional and social), mapping from the growth mindset to the fixed mindset. Furthermore, the oval shapes overlap each other, indicating that the three dimensions work together all the time, with 89% of the responses within the cognitive growth mindset; 11% within the cognitive fixed mindset, at the cognitive level; 52% of the responses within the emotional growth mindset; 48% within the emotional fixed mindset, at the emotional level; 100% of the responses within the social growth mindset; and 0% within the social fixed mindset, at the social level.

Below is a table presenting further details of Charles's case, itemising the categories with their corresponding frequencies within their dimensions respectively, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 20: Summary of Charles categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	8/9 (89% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	1/9 (11% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	12/23 (52% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	11/23 (48% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	16/16 (100% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	0/16 (0% of all categories in the social dimension are fixed mindset)

On the cognitive level, Table 20 indicates that Charles's responses were predominantly cognitive growth mindset, constituting 89% of all incidents, with the most frequent views (3 incidents) that learning mathematics is valuable, as well as viewing making mistakes as a resource in learning (3 incidents). More so, Charles believes that mathematics intelligent people are not born, but the ability can be acquired through learning, hard work and perseverance (2 incidents). In contrast, it can be noted that, in 1 incident, Charles believes that

some mathematics intelligent people are born with it, rather than acquire it through learning, hard work and perseverance. This category is within the cognitive fixed mindset.

Within the emotional dimension, Charles's responses were more of the emotional growth mindset (52%), noting that he is excited when learning mathematics (4 incidents), as well as believes in learning through practice and perseverance (3 incidents), learning with confidence (3 incidents) and learning with competence (2 incident). In contrast, Charles's responses with the most frequent responses (8 incidents) are that he is bored when learning mathematics, he discloses his laissez-faire attitudes towards learning of mathematics (3 incidents) and learning with inadequacies (3 incidents). These three categories are within the emotional fixed mindset.

In the social dimension, Charles's responses were completely social growth mindset (100%), believing that learning mathematics requires support (11 incidents), learners' attributes are inconsequential in learning mathematics (4 incidents) and participation is critical in learning the subject (1 incident).

Overall, Charles's responses during the interview indicated predominance in growth mindset within the cognitive dimension, more growth mindset within the emotional dimension and completely growth mindset within the social dimension. In the next section, I provide a qualitative analysis of selected predominant quotes within the three dimensions of learning.

6.2.5.1 Charles's cognitive growth mindset

As indicated in Table 20, Charles's responses in the interview relating to the cognitive dimension were predominantly cognitive growth mindset. One of the categories demonstrated here was that he has positive views about the usefulness and importance of learning

mathematics. This is grouped within the cognitive growth mindset. Below, I provide evidence from the interview quotes to support this point.

Interviewer:	What can you say about the kind of mathematics you do in the classroom?
Charles:	The kind of mathematics we do in the classroom is not for me because it is so hard but it is important to me [smiles].
Interviewer:	Does it show that mathematics learning is a waste of time or it is useful?
Charles:	Mathematics is useful.
Interviewer:	Why?
Charles:	Mathematics is useful because with mathematics you get to where you want to go in life and useful in the sciences.
Interviewer:	How useful is mathematics for you at the moment?
Charles:	Mathematics is very useful to me at the moment.

The above quotes by Charles reveal that he perceives mathematics and its learning as very crucial and valuable, as well as applicable to related subjects and life endeavors. These are associated with a learner who holds a growth mindset and they afford learning of the subject. Literature suggests that mathematics and its learning afford the learning of other related subjects (Obomanu & Adaramola, 2011; Maliki, Ngban & Ibu, 2009; Reyes & Stanic, 1998).

6.2.5.2 Charles's emotional fixed mindset

As indicated in Table 20, Charles's responses in the interview relating to the emotional dimension were more growth mindset. One of the categories demonstrated here was that Charles has an attitude of being bored when learning mathematics. This is grouped within the emotional fixed mindset. Below, I provide evidence from the interview quote to support this point.

Interviewer:	What do you often say about mathematics?

Charles: I sometimes say I like mathematics; I sometimes say I hate it as well. It depends on the topic or problem I am doing and how I feel [smiles]. But believe me, mathematics can be so boring [smiles].

In light of the above quote, there is evidence that Charles finds mathematics and its learning boring. This negative attitude is associated with a learner who holds a fixed mindset and it has consequences for learning mathematics as it constrains effective learning of the subject. The literature suggests that, if a learner has a negative attitude towards mathematics learning, it is reflected and/or has a negative effect on the learning of the subject (Uwerhiavwe, 2014; Darragh, 2013; Maliki, Ngban & Ibu, 2009).

6.2.5.3 Charles's social growth mindset

As indicated in Table 20, Charles's responses in the interview concerning the social dimension were completely growth mindset. One of the categories demonstrated in the social dimension was Charles's views on the social support that he gets whenever he needs or seeks support from his teacher, family members and peers. This is grouped within the social growth mindset. Below I provide evidence from the interview quotes to support this point.

Interviewer: Can you tell me some of your attitudes towards mathematics learning?

Charles: Emmm sometimes I get angry and frustrated when I do not know what to do in mathematics learning. When I am angry with a mathematics problem, I just leave it until I find someone to put me through. However, I take the difficult problems most times to my mathematics teacher to help me out with them.

Interviewer: Do your peers (classmates/other learners) help you in any way when you assistance in mathematics learning?

Charles: Yes, my peers help me when I need their assistance in mathematics.

Interviewer: Explain how, please.

Charles: My peers help me when I need their assistance in mathematics by showing and explaining to me what I ask from them.

Interviewer: Do any of your family members (siblings, parents, or guidance) contribute to your mathematics learning?

Charles: Yes, my family members contribute to my mathematics learning.

Interviewer: Explain how, please.

Charles: My family members contribute to my mathematics learning by paying for my extra classes. I get extra teachings from my family members and lesson teacher.

Charles's quotes above reveal that he gets the amount of support he needs in mathematics and its learning at home from his parents (family members), as well as the support he needs from his peers and mathematics teacher at school. These are associated with a learner who has developed a growth mindset, as they afford learning of the subject. The literature suggests that, when a learner gets his/her needed support in mathematics learning, it enhances his/her learning of the subject (Martin, 2006; Reyes & Stanic, 1998).

It is noteworthy that Charles's case is closer to Lebogang's case than the other three learners' cases, who are low achievers.

6.2.6 Summary of findings across low achievers

As previously mentioned, five learners are low achievers: Thapelo, Lebogang, Mpho, Lisa and Charles. That is three females and two males. Three of the learners are Blacks, while two of them are Whites. Each of the learners was examined in detail by exploring the influence of their inferred mindsets towards mathematics learning. Figure 13 presents a comparison of the findings of the interviews with the five learners (low achievers).

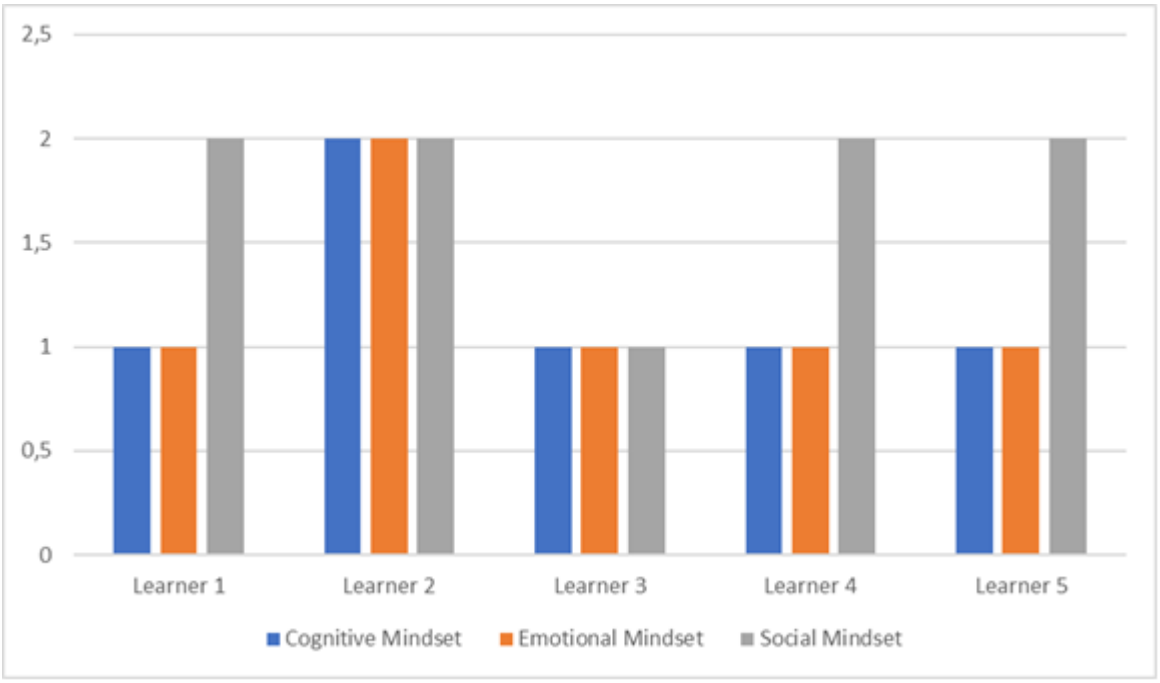


Figure 13: Five low achieving learners profiling of mindsets within Illeris's dimensions of learning

Figure 13 shows a similar pattern of mindset with learners 1 (Thapelo), learner 4 (Lisa) and learners 5 (Charles) having fixed mindset within cognitive and emotional dimensions and growth mindset within social dimension. Learner 3 (Mpho) is a classical case having a fixed mindset within all the three dimensions of learning. A typical case of a low achiever in mathematics. An interesting outcome was the case of learner 2 (Lebogang) with a growth mindset within the three dimensions of learning, however, she was categorised as a low achiever in mathematics.

In light of the analysis of findings on the basis of the five low achievers, the social dimension appeared to be viewed by the learners as a dominantly growth mindset.

Ensuing from the analysis of findings with the low achievers, the three dimensions (cognitive, emotional and social) are central, as they interplay in the learning process. More so, there are none of the low achievers who are completely (100%) growth mindset or fixed

mindset. There must be at least an element of a growth mindset and an element of a fixed mindset in a learner: For instance, a learner can have a cognitive growth mindset, as well as an emotional fixed mindset. He/she can also have a cognitive growth mindset and a cognitive fixed mindset as well.

Overall, from the analysis of findings given the learners' standpoints, there is an influence of mindset on their achievement, which is located in the cognitive, emotional and social dimensions in the learning process.

6.3 High achievers' learners

As previously mentioned in Chapter 4, race, gender and achievement levels of participants in a strongly framed and strongly classified subject (SFSCS) like mathematics were the main criteria that were used in categorising the ten learners. In this sense, five low achieving and five high achieving learners were selected and participated in this study.

In line with the above, the five learners who are in the category of high achievers are Learner 1 (Busisiwe), Learner 3 (Sipho), Learner 7 (Karl), Learner 8 (Lerato) and Learner 9 (Cindy). I, therefore, examine each of the learners in detail by exploring the influences of their inferred mindsets on the learning of mathematics. A case study of each of the five learners is subsequently given below. I present findings for each of the five learners, according to Illeris's three dimensions of learning and the Dweck's two types of mindsets, and discuss the influence of each on the learning of subjects like mathematics.

6.3.1 A case of Busisiwe

Busisiwe is a Black female who is a high achiever in mathematics learning. Figure 14 and Table 21 present summaries of the findings of the interview with Busisiwe.

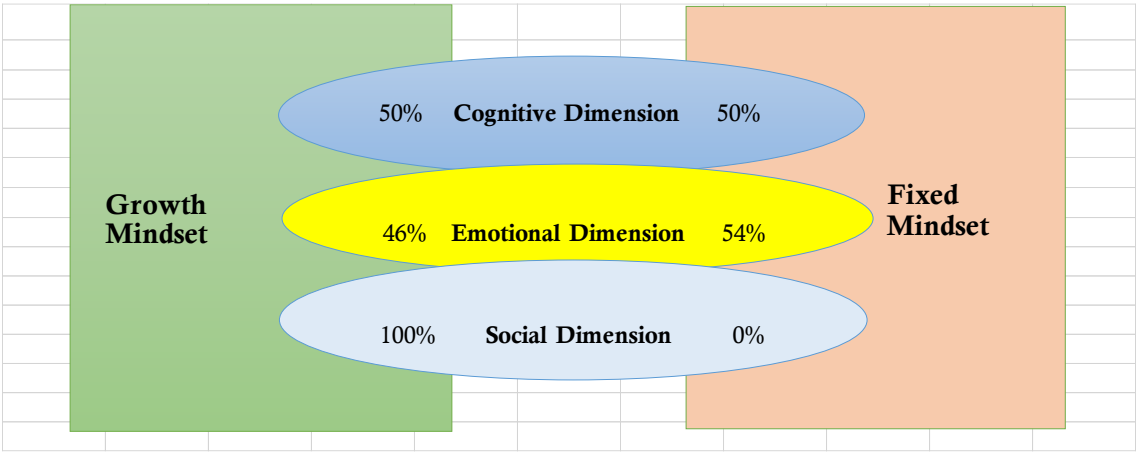


Figure 14: Busisiwe profile of mindsets within Illeris's dimensions of learning

Figure 14 shows the frequency of Busisiwe's responses in terms of the two distinct kinds of mindsets (growth mindset and fixed mindset), represented in the two rectangles with three oval shapes representing the three dimensions (cognitive, emotional and social), mapping from the growth mindset to the fixed mindset. Additionally, the oval shapes overlap each other, indicating that the three dimensions work together all the time, with 50% of the responses within the cognitive growth mindset, 50% within the cognitive fixed mindset, at the cognitive level; 46% within the emotional growth mindset; 54% within the emotional fixed mindset at the emotional level; 100% of the responses within the social growth mindset; and 0% within the social fixed mindset at the social level.

Below is a table presenting further details of Busisiwe's case, by itemising the categories with their corresponding frequencies within their dimensions respectively, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 21: Summary of Busisiwe categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	6/12 (50% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	6/12 (50% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	6/13 (46% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	7/13 (54% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	15/15 (100% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	0/15 (0% of all categories in the social dimension fixed mindset)

On the cognitive level, Table 21 indicated that Busisiwe's responses had the same frequency of incidents at the cognitive dimension: cognitive growth mindset and cognitive fixed mindset constitute 50% each of all the incidents. The most frequent responses (6 incidents) are a belief that mathematics intelligent people are born with it, rather than acquire it through learning, hard work and perseverance. This category is within the cognitive fixed mindset. Secondly, it can be noted that, in 3 incidents, Busisiwe values mathematics and perceives

mistakes as a resource for learning in 3 incidents, too. These two categories are within the cognitive growth mindset.

Within the emotional dimension, Busisiwe's responses were more emotional fixed mindset, (54%) with the most frequent responses (7 incidents) noting that she had some laissez-faire attitudes towards learning mathematics. It can also be noted that, in 4 incidents, Busisiwe noted her perceptions on learning with confidence, and perceived that she is excited when learning mathematics (1 incident) and believes in learning through practice and perseverance (1 incident). These three categories are within the emotional growth mindset.

On the social dimension, Busisiwe's responses were completely social growth mindset (100%), believing that learning mathematics requires support (9 incidents), learners' attributes are inconsequential in learning mathematics (5 incidents) and participation is critical in learning mathematics (1 incident).

Overall, Busisiwe's responses during the interview were the same in both growth mindset and fixed mindset within the cognitive dimension; more fixed mindset within emotional dimension; and completely growth mindset within the social dimension. In the next section, I provide a qualitative analysis of selected predominant excerpts, within the three dimensions of learning.

6.3.1.1 Busisiwe's cognitive fixed mindset

As indicated in Table 21, Busisiwe's responses in the interview, regarding the cognitive dimension, were equal in terms of the two mindsets: growth and fixed mindsets. The category, *born smart in learning,* has the highest number of responses in this dimension. As such, one of the categories established here was that Busisiwe showed a strong belief that

some learners are born smart in learning mathematics–that is mathematics learning is innate (inborn). This is classified within the cognitive fixed mindset. Below, I provide evidence from the interview excerpts to support this point.

Interviewer:	Must you have to be a 'special' person in order to be good in mathematics?
Busisiwe:	Yes, you have to be a 'special' person in order to be good at mathematics.
Interviewer:	Explain why.
Busisiwe:	You have to be a 'special' person in order to be good in mathematics because if you are knowledgeable in mathematics – easily do mathematics problems and get it right, then you are a special kind of person. God has created you like that [smiles]. In general, one must be special in order to learn mathematics.
Interviewer:	How will you describe yourself in the learning of mathematics?
Busisiwe:	Emmm I will say that I am gifted in mathematics. I consider myself even knowledgeable in mathematics than those who say that mathematics would be very useful to them in their future career.

The excerpts above infer that Busisiwe strongly believes that some learners are born with the intelligence to learn mathematics effectively–some learners have a distinct knowledge and understanding of mathematics from God. In other words, being knowledgeable in mathematics and its learning is inborn (innate). These beliefs are associated with a learner who holds a fixed mindset and may have consequences for the learning of the subject, as the literature suggests that they deter effective learning (Zhang, Kuusisto & Tirri, 2017; Boaler, 2013).

6.3.1.2 Busisiwe's emotional fixed mindset

As indicated in Table 21, Busisiwe's responses in the interview relating to the emotional dimension were more fixed mindset. One of the categories established here was Busisiwe's laissez-faire attitude towards mathematics learning. This is classified within the emotional fixed mindset. Below, I provide evidence from the interview excerpts to support this point.

Interviewer: When you are stuck on a mathematics problem or when you get something wrong, what do you do or say?

Busisiwe: I feel sad and frustrated when I am stuck on a mathematics problem. More so, when I look at the problem, I just feel that it is going to take ages to get it right. So, I just leave it.

Interviewer: What do you often say about mathematics?

Busisiwe: Sometimes I feel so tired of mathematics.

Interviewer: Why?

Busisiwe: Sometimes I feel so tired about mathematics when emmm a problem just frustrates me and I do not know what to do. I do not continue with the problem.

The above excerpts display Busisiwe's disposition of a lack of determination and perseverance in learning mathematics. Busisiwe does not persist when she is stuck in a mathematics problem. She is not committed to learning mathematics but leaves or discontinues solving mathematics problems when faced with challenges in learning mathematics. These dispositions are indications of a fixed mindset and they constrain learning and lead to failure in the subject. The literature suggests that a learner with a fixed mindset does not see the need to improve his/her abilities more through practice and perseverance in mathematics learning, instead he/she prefers to avoid and/or quit on challenges (Haimovitz & Dweck, 2017; Boaler, 2013).

6.3.1.3 Busisiwe's social growth mindset

As indicated in Table 21, Busisiwe's responses in the interview regarding the social dimension were completely growth mindset. One of the categories established here was Busisiwe's views on the social support that she gets, whenever she needs or seeks support, from her teacher, family members and peers. This is classified within the cognitive social mindset. Below, I provide evidence from the interview excerpts to support this point.

Interviewer: Do your peers (classmates/other learners) help you in anyways help you when you need assistance in mathematics learning?

Busisiwe: Yes, my classmates help me when I need their assistance in mathematics learning. However, I hardly go to other learners for help. Instead, I do not continue with the problem(s) except when the mathematics teacher calls for correction or revision on it.

Interviewer: Do your peers (classmates/other learners) assist you in doing your mathematics assignments (classwork)?

Busisiwe: Yes, my peers assist me in mathematics group classwork when I ask them.

Interviewer: Do any of your family members (siblings, parents, or guidance) contribute to your mathematics learning?

Busisiwe: Yes, my family members contribute to my mathematics learning.

Interviewer: Explain how, please.

Busisiwe: My granny (grandmother) and brother help me in mathematics learning whenever I need them and ask them for help.

Interviewer: Do any of your family members (siblings, parents, or guidance) assist you in doing your mathematics assignments (homework)?

Busisiwe: Yes, my brother does assist me with my mathematics homework when I ask him to.

Interviewer: What about your teacher?

Busisiwe: My mathematics teacher is always excited about teaching the class. My teacher is always there for your needs to help you out.

The excerpts from the interview with Busisiwe show that she gets the amount of support she needs in mathematics and its learning at home from their parents (family members), as well as the support she needs from her peers and mathematics teacher at school. These are associated with a learner who has developed a growth mindset, because they afford learning of the subject. It is essential to note that, when a learner is given the support that he/she needs in mathematics learning, it affords the learning of the subject (Martin, 2006; Reyes & Stanic, 1998).

6.3.2 A case of Sipho

Sipho is a Black male who is a high achiever in mathematics learning. Figure 15 and Table 22 present summaries of the findings of the interview with Sipho.

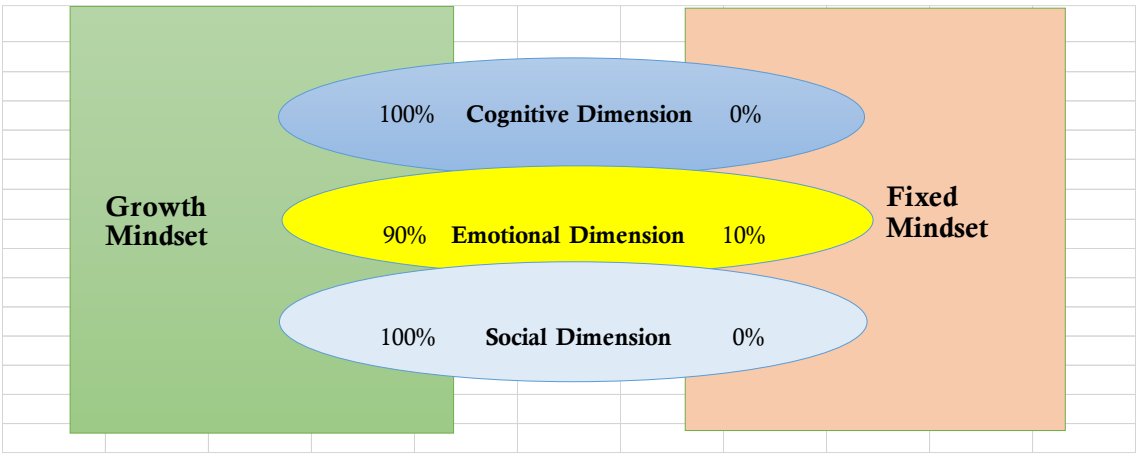


Figure 15: Sipho profile of mindsets within Illeris's dimensions of learning

Figure 15 shows Sipho's frequencies of responses, with 100% within the cognitive growth mindset; 0% within the cognitive fixed mindset, at the cognitive level; 90% within the emotional growth mindset; 10% within the emotional fixed mindset, at the emotional level; 100% of the responses within the social growth mindset; and 0% within the social fixed mindset, at the social level.

Below is a table presenting further details of Sipho's case, by itemising the categories with their corresponding frequencies within their dimensions respectively, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 22: Summary of Sipho categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	10/10 (100% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	0/10 (0% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	12/15 (90% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	3/15 (10% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	10/10 (100% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	0/10 (0% of all categories in the social dimension are fixed mindset)

On the cognitive level, Table 22 indicates that Sipho's responses were completely cognitive growth mindset (100% of all incidents), with the most frequent responses in 4 incidents believing that learning mathematics is not inborn (innate). More so, Sipho mentioned some views about the values of mathematics (4 incidents), as well as his perception of mistakes as a resource for learning (2 incidents).

Within the emotional dimension, Sipho's responses were predominantly emotional growth mindset (90% of all incidents), with most frequent responses believing in learning through practice and perseverance (4 incidents), as well as feeling excited when learning (4 incidents). Furthermore, Sipho's responses indicate learning with confidence (3 incidents) and learning with competence (1 incident). Conversely, Sipho also acknowledges, in 2 incidents, her attitudes of being bored when learning mathematics and, in 1 incident, her laissez-faire attitude towards learning mathematics. These categories are within the emotional fixed mindset.

In the social dimension, Sipho's responses were completely social growth mindset (100%), believing that learning mathematics requires support (7 incidents), as well as that learners' attributes are inconsequential in learning mathematics (3 incidents).

Overall, Sipho's responses during the interview indicated a complete growth mindset within the cognitive and social dimensions and a predominance in growth mindset, within the emotional dimension. In the next section, I provide a qualitative analysis of selected predominant extracts within the three dimensions of learning.

6.3.2.1 Sipho's cognitive growth mindset

As indicated in Table 22, Sipho's responses in the interview regarding the cognitive dimension were completely a fixed mindset. One of the categories demonstrated here was that Sipho has a strong belief that learners are not born smart in learning mathematics, that mathematics learning is not innate (inborn). This is classified within the cognitive growth mindset. Below, I provide evidence from the interview extracts to support this point.

Interviewer: Must you have to be a 'special' person in order to be good at mathematics?

Sipho: No ooo, I do not think so.

Interviewer: Explain, please.

Sipho: I do not think that one has to be a 'special' person in order to be good in mathematics. This is so because you just have to read and practice mathematics to be good at it.

Interviewer: Is there anything else you would like to say about mathematics learning? Is there any other challenge you may want to say?

Sipho: Emmm one must not be gifted to do or study mathematics properly. I think you will be capable of doing mathematics if you are focused on doing it [smiles].

The extracts from the interview with Sipho reveal he thinks that learners are not talented or born to learn mathematics effectively. Simply put, no one is born smart in learning mathematics, as being smart or good at mathematics can be learned. These beliefs are related to a learner who has constructed a growth mindset and they afford learning of the subject. Hence, the literature suggests that these beliefs enhance effective learning of mathematics (Bernecker et al, 2019; Dweck, 2006b).

6.3.2.2 Sipho's emotional growth mindset

As indicated in Table 22, Sipho's responses in the interview relating to the emotional dimension were predominantly growth mindset. One of the categories demonstrated here was that Sipho feels excited when learning mathematics. This is classified within the emotional growth mindset. Below, I provide evidence from the interview extracts to support this point.

Interviewer: Do you feel happy whenever it's time for mathematics class?

Sipho: Yes, I do feel happy whenever it is time for mathematics class. I rejoice at doing mathematics.

Interviewer: How will you describe yourself in the learning of mathematics?

Sipho: I am always happy when I am learning mathematics.

Interviewer: Why?

Sipho: I am always happy and feel excited when I am learning mathematics because I really enjoy doing mathematics.

In light of the above extracts from the interview with Sipho, there are indications that he finds mathematics and its learning exciting and enjoyable, hence, he feels interested in learning mathematics, as well as happy when learning the subject. These attitudes point to a learner who holds a growth mindset and enhance learning of the subject. The literature suggests that, if a learner has a positive attitude towards mathematics learning, it is reflected and/or has a positive effect on the learning of the subject (Uwerhiavwe, 2014; Darragh, 2013; Maliki, Ngban & Ibu, 2009).

6.3.2.3 Sipho's social growth mindset

As indicated in Table 22, Sipho's responses in the interview regarding the social dimension were completely growth mindset. One of the categories demonstrated here was Sipho's perceptions of the social support that he gets whenever he needs or seeks support from his mathematics teacher, family members and peers. This is classified within the social growth mindset. Below, I provide evidence from the interview extracts to support this point.

Interviewer: When you are stuck on a mathematics problem or when you get something wrong, what do you do or say?

Sipho: When I am stuck on a mathematics problem, I ask the mathematics teacher. However, if the mathematics teacher is not available for me to ask him, I keep on practicing the problem until I get it right or see the mathematics teacher.

Interviewer: What about other learners?

Sipho: When I am stuck on a mathematics problem, the other learners help me to figure it out if they can [smiles].

Interviewer: What about your teacher?

Sipho: When I am stuck on a mathematics problem, my teacher helps me out when she is told about it or available.

Interviewer: What about your family members?

Sipho: When I am stuck on a mathematics problem, my uncle helps me.

The extracts from the interview with Sipho point out that he gets the amount of support he needs in mathematics and its learning at home from his parents (family members), as well as the support he needs from their peers and mathematics teachers at school. These are associated with a learner who has developed a growth mindset and they afford learning of the subject. When a learner gets the amount of necessary support that he/she needs in mathematics learning, it enhances the effective learning of the subject (Martin, 2006; Reyes & Stanic, 1998).

It is critical to note that Sipho's case is a case of classic profile, as it is a growth mindset being associated with learners who are high achievers (a profile that fits the expectations).

6.3.3 A case of Karl

Karl is a White male who is a high achiever in mathematics learning. Figure 16 and Table 23 present summaries of the findings of the interview with Karl.

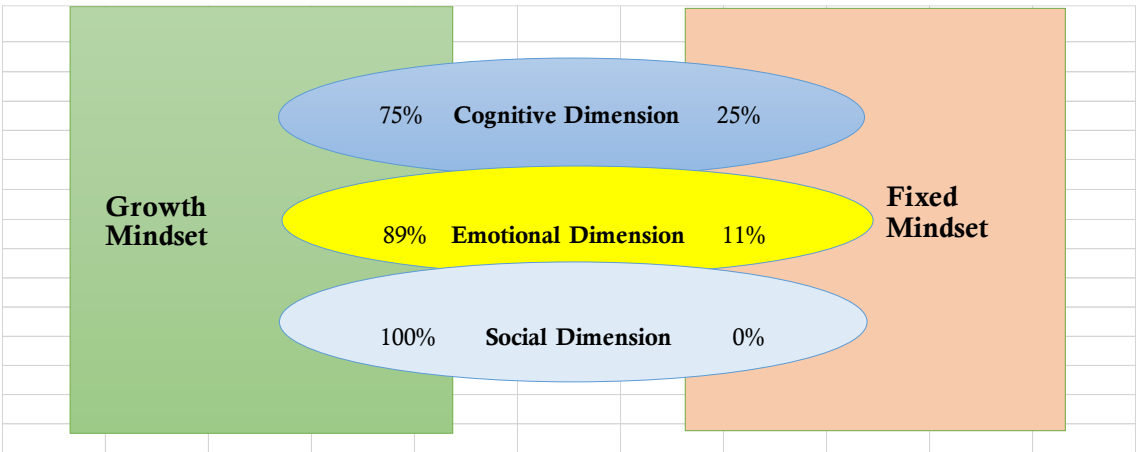


Figure 16: Karl profile of mindsets within Illeris's dimensions of learning

Figure 16 shows Karl's frequencies, with 75% of the responses within the cognitive growth mindset; 25% within the cognitive fixed mindset at the cognitive level; 89% within the emotional growth mindset; 11% within the emotional fixed mindset, at the emotional level; 100% of the responses within the social growth mindset; and 0% within the social fixed mindset, at the social level.

Below is a table presenting further details of Karl's case by itemising the categories with their corresponding frequencies within their dimensions respectively, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 23: Summary of Karl categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	9/12 (75% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	3/12 (25% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	16/18 (89% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	2/18 (11% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	21/21 (100% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning (0) Non-participation in class	0/21 (0% of all categories in the social dimension are fixed mindset)

On the cognitive level, Table 23 indicates that Karl's responses were predominantly cognitive growth mindset, constituting 75% of all incidents, with the most frequent responses relating to his belief that learning mathematics is valuable (6 incidents). Furthermore, Karl views making mistakes as a resource for mathematics learning (2 incidents), as well as, in 1 incident, believes that mathematics intelligent people are not born, i.e. he believes that learning mathematics is not innate (inborn). On the contrary, it can be noted that Karl

believes that mathematics intelligent people are born with it, rather than acquiring it through learning, hard work and perseverance (2 incidents), as well as views committing errors as a setback in learning mathematics (1 incident). These two categories are within the cognitive fixed mindset.

Within the emotional dimension, Karl's responses were also predominantly emotional growth mindset (89%), believing in learning mathematics through practice and perseverance (6 incidents), learning with confidence (6 incidents), excited when learning (3 incidents) and learning mathematics with competence (1 incident). On the contrary, in one incident, Karl also acknowledges his attitude of feeling bored when learning mathematics, as well as 1 incident of his laissez-faire attitude towards learning mathematics. These two categories are within the emotional fixed mindset.

In the social dimension, Karl's responses were completely social growth mindset (100%), indicating that he believes that learning mathematics requires support (16 incidents) and learners' attributes are inconsequential in learning mathematics (5 incidents).

Overall, Karl's responses during the interview indicated predominance in growth mindset, within cognitive and emotional dimensions, and completely growth mindset, within the social dimension. In the next section, I provide a qualitative analysis of selected predominant extracts within the three dimensions of learning.

6.3.3.1 Karl's cognitive growth mindset

As indicated in Table 23, Karl's responses in the interview relating to the cognitive dimension were predominantly cognitive growth mindset. One of the categories illustrated

here was Karl's views about the usefulness and importance of learning mathematics. This is grouped within the cognitive growth mindset. Extracts below exemplify this finding.

Interviewer:	Does it show that mathematics learning is a waste of time or it is useful?
Karl:	Mathematics learning is not a waste of time; which means that mathematics is very useful.
Interviewer:	How useful is mathematics for you at the moment?
Karl:	At the moment, emmm mathematics is useful because I can help people with it. Sir, not only that; nowadays, I can calculate very fast and use it very well in my other subjects [smiles].

The above extracts from the interview with Karl indicate that he perceives mathematics and its learning as crucial and valuable, as well as applicable to other related subjects. These are associated with a learner who holds a growth mindset and they afford learning of the subject. Literature suggests that the knowledge of mathematics enhances the learning and/or the understanding of other related subjects (Obomanu & Adaramola, 2011; Maliki, Ngban & Ibu, 2009).

6.3.3.2 Karl's emotional growth mindset

As indicated in Table 23, Karl's responses in the interview regarding the emotional dimension were predominantly growth mindset. One of the categories illustrated here was Karl's responses concerning his attitudes regarding his confidence in learning mathematics. This is grouped within the cognitive growth mindset. Extracts below exemplify this finding.

Interviewer:	Please tell me about your confidence in mathematics?
Karl:	Yes, I feel confident in doing mathematics. Last year, I was not confident. But this year, I am confident.
Interviewer:	Why? Please explain.

Karl: I was not confident in doing mathematics last year because I was so playful. This year, I am confident in doing mathematics because I am not playful; more so, I have a teacher that inspires me in mathematics as well.

There are indications from extracts from the interview with Karl that he is self-confident in mathematics and its learning. This is related to a learner who has developed a growth mindset, as it affords learning mathematics. The literature suggests that a learner who is self-confident in mathematics learning performs well and he/she is successful in learning the subject (Darragh, 2013; Graven, 2013).

6.3.3.3 Karl's social growth mindset

As indicated in Table 23, Karl's responses in the interview, regarding the social dimension, were completely growth mindset. One of the categories illustrated here was Karl's views on the social support that he gets whenever he needs or seeks support from his mathematics teacher, family members and peers. This is grouped within the cognitive growth mindset. Extracts below exemplify this finding.

Interviewer: Do your peers (classmates/other learners) help you in anyways help you when you need assistance in mathematics learning?

Karl: Yes, when I ask my classmates for help in mathematics learning, they render it to me. I go to the mathematics teacher for help because he is always ready to assist with mathematics issues also.

Interviewer: Do any of your family members (siblings, parents, or guidance) contribute to your mathematics learning?

Karl: Yes, my family members assist me in my mathematics learning.

Interviewer: Explain how.

Karl: My sister assists me when I ask for assistance from her in mathematics learning. She has textbooks for grades 10 and 11; so, she takes out exercises from those textbooks and through them with me, Sir.

Interviewer: Do any of your family members (siblings, parents, or guidance) assist you in doing your mathematics assignments (homework)?

Karl:	Yes, my family members assist me with my mathematics homework when I ask for assistance. However, they give me methods but not answers.
Interviewer:	How has what they (other learners, teachers, or family members) said made you think about mathematics?
Karl:	All that my mathematics teacher and family member have said about mathematics have really inspired, empowered and motivated me to do more in mathematics.

The above extracts from the interview with Karl indicate that he gets the amount of support he needs in mathematics and its learning at home from his parents (family members), as well as the support he needs from his peers and mathematics teacher at school. These are associated with a growth mindset, because they afford learning. The literature suggests that when learners get the amount of support they need in mathematics learning, it improves their learning of the subject. (Martin, 2006; Nasir & Hand, 2006).

It is worth noting that Karl's case is another case of classic profile, as it is a growth mindset associated with learners who are high achievers, i.e. a profile that fits the expectations, which is similar to Sipho's case.

6.3.4 A case of Lerato

Lerato is a Black female who is a high achiever in mathematics learning. Figure 17 and Table 24 present summaries of the findings of the interview with Lerato.

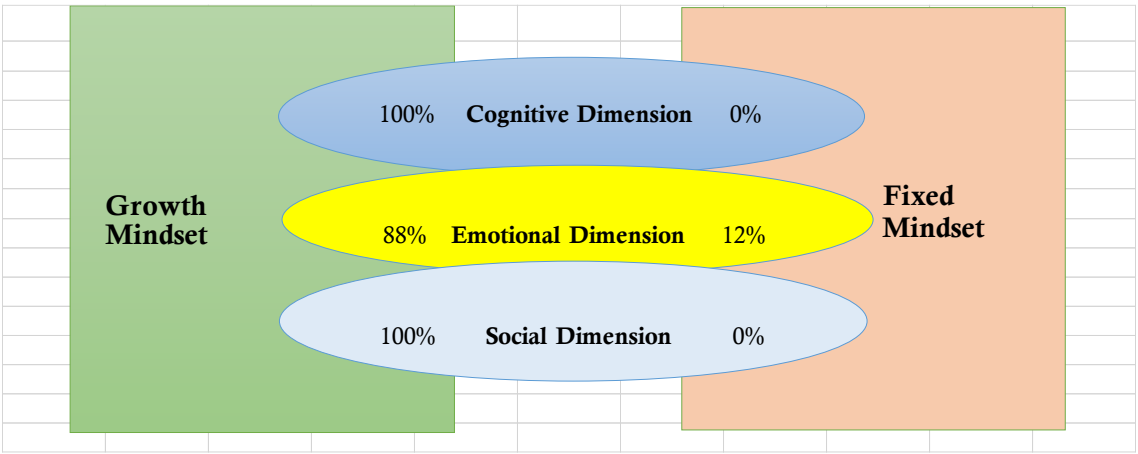


Figure 17: Lerato profile of mindsets within Illeris's dimensions of learning

Figure 17 shows Lerato's frequencies of responses with 100% of the responses within the cognitive growth mindset; 0% within the cognitive fixed mindset, at the cognitive level; 88% of the responses within the emotional growth mindset; 12% within the emotional fixed mindset, at the emotional level; 100% within the social growth mindset; 0% within the social fixed mindset at the social level.

Below is a table presenting further details of Lerato's case by itemising the categories with their corresponding frequencies within their dimensions respectively, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 24: Summary of Lerato categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	19/19 (100% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	0/19 (0% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	22/25 (88% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	3/25 (12% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	15/15 (100% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	0/15 (0% of all categories in the social dimension are fixed mindset)

On the cognitive level, Table 24 indicates that Lerato's responses were completely cognitive growth mindset (100% of all incidents), with the most frequent responses of that learning mathematics is valuable (11 incidents). More so, Lerato views making mistakes as a resource in mathematics learning (4 incidents) and, in 4 incidents, believes that mathematics intelligent people are not born, i.e. she believes that learning mathematics is not innate (inborn).

Within the emotional dimension, Lerato's responses were predominantly emotional growth mindset (88%), in 13 incidents, which indicated her belief in learning through practice and perseverance. More so, Lerato's responses indicate that she feels excited when learning (7 incidents). She likewise cited learning with confidence (2 incidents) and learning with competence (1 incident). However, Lerato also acknowledges her attitudes of learning with uncertainty (2 incidents) and boredom when learning mathematics (1 incident). These two categories are within the emotional fixed mindset.

In the social dimension, Lerato's responses were completely social growth mindset (100%), believing that learning mathematics requires support (12 incidents), learners' attributes are inconsequential in learning mathematics (2 incidents) and learning through participation (1 incident).

Overall, Lerato's responses during the interview indicated a complete growth mindset, within cognitive and social dimensions and a predominance in growth mindset, within the emotional dimension. In the next section, I provide a qualitative analysis of selected predominant assertions within the three dimensions of learning.

6.3.4.1 Lerato's cognitive growth mindset

As indicated in Table 24, Lerato's responses in the interview relating to the cognitive dimension were predominantly growth mindset. One of the categories exemplified here was Lerato's views about the usefulness and importance of learning mathematics. This is classified within the cognitive growth mindset. The assertions below exemplify this finding.

Interviewer: Does it show that mathematics learning is a waste of time or it is useful?

Lerato: Mathematics is not a waste of time, but very useful to me.

Interviewer: Why?

Lerato: Mathematics is very useful because it is important and it is in most criteria to move forward in life.

Interviewer: Are you committed to mathematics?

Lerato: Yes, I am committed to mathematics always.

Interviewer: Please explain how.

Lerato: I am committed to mathematics always because like I said before, mathematics helps me to choose other subjects and what I want to become in life, as well as knowing the other subject better.

Interviewer: What do you often say about mathematics?

Lerato: Emmm I just see mathematics as a subject that everyone needs in life personally. More so, mathematics is an important subject everyone needs to pass.

The above quotes by Lerato depict that she perceives mathematics and its learning as very crucial and valuable, as well as applicable in most areas of life, such as future career choice, choice-making and good knowledge of other subjects. These are connected with a learner who holds a growth mindset and they afford learning of the subject. The literature suggests that mathematics knowledge enhances effective learning of other subjects, as well as seeing it as applicable to our day-to-day activities (Maliki, Ngban & Ibu, 2009; Reyes & Stanic, 1998).

6.3.4.2 Lerato's emotional growth mindset

As indicated in Table 24, Lerato's responses in the interview regarding the emotional dimension were predominantly growth mindset. One of the categories exemplified here was Lerato's responses indicating her attitudes regarding learning mathematics through practice and perseverance. This is classified within the cognitive growth mindset. The assertions below exemplify this finding.

Interviewer: Are you determined in learning mathematics?

Lerato: Yes, I am determined in learning mathematics.

Interviewer: How will you describe yourself in the learning of mathematics?

Lerato: In mathematics learning, I will describe myself as a learner who understands mathematics. I enjoy mathematics, I am good at it and it is fun to me as well. I have a great mathematics teacher.

Interviewer: So, when you are stuck on a mathematics problem or when you get something wrong, what do you do or say?

Lerato: When I am stuck on a mathematics problem, I keep practicing until I find out that I understand it without difficulties and can do it right.

The above assertions by Lerato depict that she reads and practises mathematics and she has self-determination in learning it. As such, whenever she is stuck with a mathematics problem, she persists until she understands and has good knowledge of it, as well as ensures that she gets it (problem) correctly. These attitudes are associated with learners with a growth mindset and they afford success in learning the subject as learners improve their capabilities through practice and perseverance (Appell, 2019; Haimovitz & Dweck, 2017).

6.3.4.3 Lerato's social growth mindset

As indicated in Table 24, Lerato's responses in the interview regarding the social dimension were completely growth mindset. One of the categories exemplified here was Lerato's perceptions of the social support that she gets whenever she needs, or seeks support from her mathematics teacher, family members and peers. This is classified within the cognitive social mindset. The assertions below exemplify this finding.

Interviewer: Do you have a sense of belonging (feels accepted and comfortable) in the mathematics classroom?

Lerato: Yes.

Interviewer: Why? Explain, please.

Lerato: Yes, I feel accepted and comfortable in the mathematics classroom because our teacher is the best. He helps me to understand mathematics very well. At the moment, I am fine with what I was scared of and did not understand in mathematics last year.

Interviewer: Is there a good teacher/learner relationship with your mathematics teacher?

Lerato: Yes, there is a good relationship with my mathematics teacher.

Interviewer: If yes/no, how would you describe your relationship with the mathematics teacher?

Lerato: There is a good relationship with my mathematics teacher because I see him as my tutor and he helps me understand mathematics better.

Interviewer: Do your peers (classmates/other learners) help you in any way when you need assistance in mathematics learning?

Lerato: Yes, they do.

Interviewer: Explain how.

Lerato: When I ask my peers for assistance in mathematics, they help me and I do it myself until I understand [smiles].

Interviewer: Do any of your family members (siblings, parents, or guidance) contribute to your mathematics learning?

Lerato: Yes, my mother does help me in mathematics learning.

Interviewer: Do any of your family members (siblings, parents, or guidance) assist you in doing your mathematics assignments (homework)?

Lerato: Yes, my family members assist me at home with my mathematics.

Lerato's responses point out that she gets the amount of support she needs in mathematics and its learning at home from their parents (family members), as well as the support she needs from her peers and mathematics teachers at school. These are associated with a learner who has developed a growth mindset and they afford learning of the subject. It is possible for learners to perform well when they get the amount of support they need for learning the subject (Martin, 2006; Nasir & Hand, 2006; Reyes & Stanic, 1998).

It is essential to note that Lerato's case is also another case of classic profile, as it is a growth mindset being associated with learners who are high achievers, i.e. a profile that fits the expectations, which is similar to Sipho's and Karl's cases.

6.3.5 A case of Cindy

Cindy is a White female who is a high achiever in mathematics learning. Figure 18 and Table 25 present summaries of the findings of the interview with Cindy.

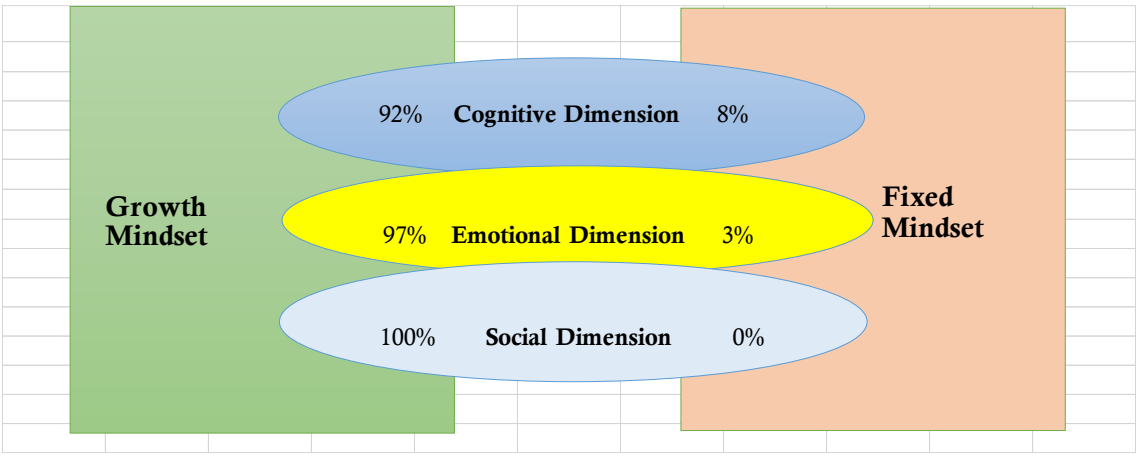


Figure 18: Cindy's profile of mindsets within Illeris's dimensions of learning

Figure 18 shows Cindy's frequencies of responses, with 92% of the responses within the cognitive growth mindset; 8% within the cognitive fixed mindset, at the cognitive level; 97% within the emotional growth mindset; 3% within the emotional fixed mindset, at the emotional level; 100% of the responses within the social growth mindset; 0% within the social fixed mindset, at the social level.

Below is a table presenting further details of Cindy's case, itemising the categories with their corresponding frequencies within their dimensions respectively, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 25: Summary of Cindy categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	11/12 (92% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	1/12 (8% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	38/39 (97% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	1/39 (3% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	16/16 (100% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	0/16 (0% of all categories in the social dimension are fixed mindset)

On the cognitive level, Table 25 indicated that Cindy's responses were predominantly cognitive growth mindset constituting 92%, believing with the most frequent responses, that learning mathematics is valuable (5 incidents). More so, 3 incidents indicate that Cindy believes that learning mathematics is not inborn (innate). 3 incidents likewise indicate she views mathematics learning as important and useful. On the contrary, it can be noted, in 1

incident, that Cindy views mathematics learning as not important and useful. This category is within the cognitive fixed mindset.

Within the emotional dimension, Cindy's responses were also predominantly emotional growth mindset (97%); believing in learning through practice and perseverance (15 incidents); noting that she is excited when learning (9 incidents); as well as her attitudes toward learning with confidence (2 incidents) and learning with competence (2 incident). In contrast, Cindy also acknowledges, in 1 incident, her attitude of learning with uncertainty in learning mathematics. This category is within the emotional fixed mindset.

In the social dimension, Cindy's responses were completely social growth mindset (100%), believing that learning mathematics requires support (13 incidents), learners' attributes are inconsequential in learning mathematics (5 incidents) and participation is critical in learning the subject (2 incidents).

Overall, Cindy's responses during the interview indicated predominance in growth mindset, within cognitive and emotional dimensions and completely growth mindset, within the social dimension. In the next section, I provide a qualitative analysis of selected predominant abstracts within the three dimensions of learning.

6.3.5.1 Cindy's cognitive growth mindset

As indicated in Table 25, Cindy's responses in the interview relating to the cognitive dimension were predominantly cognitive growth mindset. One of the categories demonstrated here was that Cindy had positive views about the usefulness and importance of learning mathematics. This is grouped within the cognitive growth mindset. Extracts below exemplify this finding.

Interviewer: How useful is mathematics for you at the moment?

Cindy: Mathematics is really fun for me at the moment and useful because I am in a new grade and I learn a lot of new stuff in mathematics. This new stuff I am learning in mathematics is very easy and you find some of them in other subjects and they help[laughs].

Interviewer: Does it show that mathematics learning is a waste of time or it is useful?

Cindy: Mathematics learning is very useful, especially in everyday life. Like when you go to shops to buy stuff, you will definitely calculate - this is very often.

Interviewer: Will mathematics be important for your future career?

Cindy: I am not really sure if mathematics will be important for my future career, but I think it will be important because it is compulsory.

The above extracts by Cindy infer that she perceives mathematics and its learning as critical and valuable, as well as applicable to other related subjects. These ideas are related to a learner who holds a growth mindset and they afford learning of the subject, as the literature suggests that mathematics knowledge enhances the understanding of related subjects (Obomanu & Adaramola, 2011; Maliki, Ngban & Ibu, 2009).

6.3.5.2 Cindy's emotional growth mindset

As indicated in Table 25, Cindy's responses in the interview regarding the emotional dimension were predominantly growth mindset. One of the categories demonstrated here was Cindy's responses in her attitudes regarding her confidence in learning mathematics. This is grouped within the cognitive growth mindset. Extracts below exemplify this finding.

Interviewer: Do you read and practice mathematics?

Cindy: Yes, I do read and practice mathematics.

Interviewer: Are you determined in learning mathematics?

Cindy: Yes, I am very determined in learning mathematics.

Interviewer: Please tell me about your experience in mathematics learning at the moment.

Cindy: I have learned that as the teacher explains and you go through your work over and over again, you will understand mathematics very well. Just like what you, Mr. Abel said that we should practice and practice; that is what our mathematics teacher has been doing. This has helped me a lot because I practice and go through mathematics always.

Interviewer: How will you describe yourself in the learning of mathematics?

Cindy: I describe myself as really dedicated and hardworking towards my work in mathematics learning.

The above extracts from the interview with Cindy infer that she puts extra effort into reading and practising mathematics regularly for her to have a good grasp of it, as the subject requires perseverance and extra efforts to be able to understand it properly, since efforts are not seen as a substitute for talent but to improve. These are associated with a learner who holds a growth mindset and they afford success in learning the subject. Hence, the literature suggests with a growth mindset improves their abilities at practising and persisting in the learning process (Haimovitz & Dweck, 2017; Popova, 2014).

6.3.5.3 Cindy's social growth mindset

As indicated in Table 25, Cindy's responses in the interview regarding the social dimension were completely growth mindset. One of the categories demonstrated here was Cindy's views on the social support that she gets whenever she needs, or seeks, support from her mathematics teacher, family members and peers. This is grouped within the cognitive growth mindset. Extracts below exemplify this finding.

Interviewer: When you are stuck on a mathematics problem or when you get something wrong, what do you do or say?

Cindy: When I am are stuck on a mathematics problem I get very down, but then I get my teacher to help me and show me the right way. As soon as he helps me, I feel much better and I see where I went wrong.

Interviewer: What about your family members?

Cindy: When I am stuck on a mathematics problem at home, I ask my father, mother, or siblings about it; and they will normally tell me like, this is what you do, or just check with your mathematics teacher.

Interviewer: Do you do your assignments, that is, classwork and homework?

Cindy: Yes, I always do my assignments [smiles].

Interviewer: Do your peers (classmates/other learners) help you in anyways help you when you need assistance in mathematics learning?

Cindy: Yes, my peers do help me when I need their assistance in mathematics.

Interviewer: How? Please explain.

Cindy: My peers do help me when I need their assistance in mathematics because when I do not know a problem and I am confused, I do ask them; but they help me a lot like they say do not do that, this is how you do it and so on.

Interviewer: Do your peers (classmates/other learners) assist you in doing your mathematics assignments (classwork)?

Cindy: If it is in groups, yes, my peers assist in doing mathematics classwork; but if it is alone, no, my peers do not assist in doing my mathematics classwork because we all keep to ourselves when we do it alone.

Interviewer: Do you assist your peers (classmates/other learners) in doing their mathematics assignments (classwork)?

Cindy: Yes, I do assist them in their mathematics classwork when they need help or struggling to do something.

Interviewer: Do any of your family members (siblings, parents, or guidance) assist you in doing your mathematics assignments (homework)?

Cindy: Yes, my family members do assist me a lot in doing my mathematics homework when I need them - especially my siblings who just finished school last year. I always go to them (siblings) if I do not understand something because they have more knowledge than me.

The extracts from the interview with Cindy show that she gets the amount of support she needs in mathematics and its learning at home from their parents (family members), as well as the support she needs from her peers and mathematics teachers at school. These are associated with a learner who has constructed a growth mindset and they enhance learning of the subject. Notably, learners achieve more when they get the necessary amount of support from people (Nasir & Hand, 2006; Reyes & Stanic, 1998).

It is vital to note that Cindy's case is yet another classic profile, as it is a growth mindset being associated with learners who are high achievers, i.e. a profile that fits the expectations, which is similar to Sipho's, Karl's and Lerato's cases.

6.3.6 Summary of findings across high achievers

As previously mentioned, five learners are high achievers: Busisiwe, Sipho, Karl, Lerato and Cindy. That is three females and two males – three of the learners are Blacks, while two of them are Whites. Each of the learners was examined in detail by exploring the influences of their inferred mindsets on the learning of a SFSCS, such as mathematics. Figure 19 presents a comparison of the findings of the interviews with the five learners (high achievers).

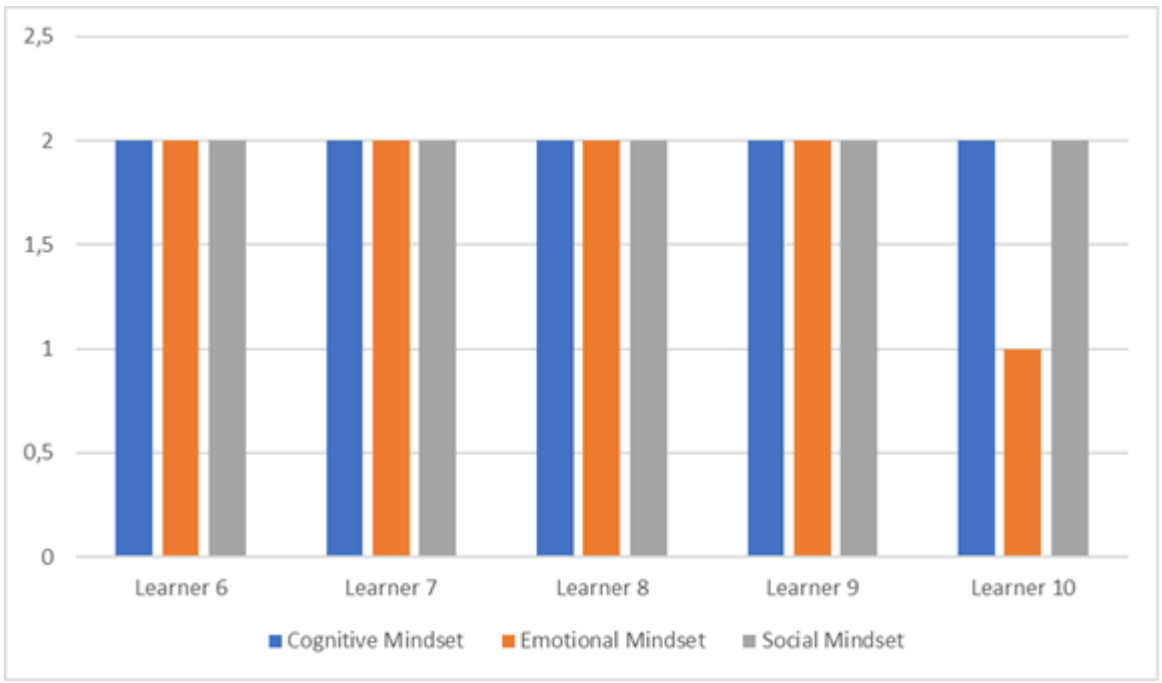


Figure 19: Five high achievers learners profiling of mindsets within Illeris's dimensions of learning

Figure 19 shows a similar pattern of mindset with learners 6 (Busisiwe), 7 (Sipho), 8 (Karl) and 9 (Lerato), presenting a classic case of high achievers with growth mindsets within all the

three dimensions of learning. Learner 10 (Cindy) demonstrates a fixed mindset within the emotional dimension of learning.

Drawing from the analysis of findings given by the high achievers, the three dimensions (cognitive, emotional and social) are central, as they overlap in the learning process. More so, there are none of the high achievers who are completely (100%) growth mindset. There is at least an element of a fixed mindset in a learner, but of course predominantly growth. A learner possesses at least an element of the two kinds of mindsets. In all, from the analysis of findings giving the learners' perspectives, there is an influence of mindset on their achievement, which is located in the cognitive, emotional and social dimensions in the learning process.

6.4 Synthesis of findings across the ten case studies

As previously mentioned, there are ten learners with five low achievers: Thapelo, Lebogang, Mpho, Lisa and Charles; and five high achievers: Busisiwe, Sipho, Karl, Lerato and Cindy. Also, there are six females and four males. Six of the learners are Blacks, while four of them are Whites. I have examined each of the learners in detail by exploring the influences of their inferred mindsets on the learning of a SFSCS, such as mathematics. As such, Figure 20 presents a comparison of the findings of the interviews with the ten learners. In order to present the chart [in Figure 20] below, I allocated the value 1 to learners' fixed mindset; the value 1.5 to the situation whereby a learner's fixed mindset is similar to the learner's growth mindset (i.e. where a learner's fixed and growth mindsets have the same number of responses); and the value 2 to learners' growth mindset. That is, when a response about fixed mindset is similar to a growth mindset, it is 1.5; when it is a fixed mindset, it is 1; and when a response is about growth mindset, it is 2.

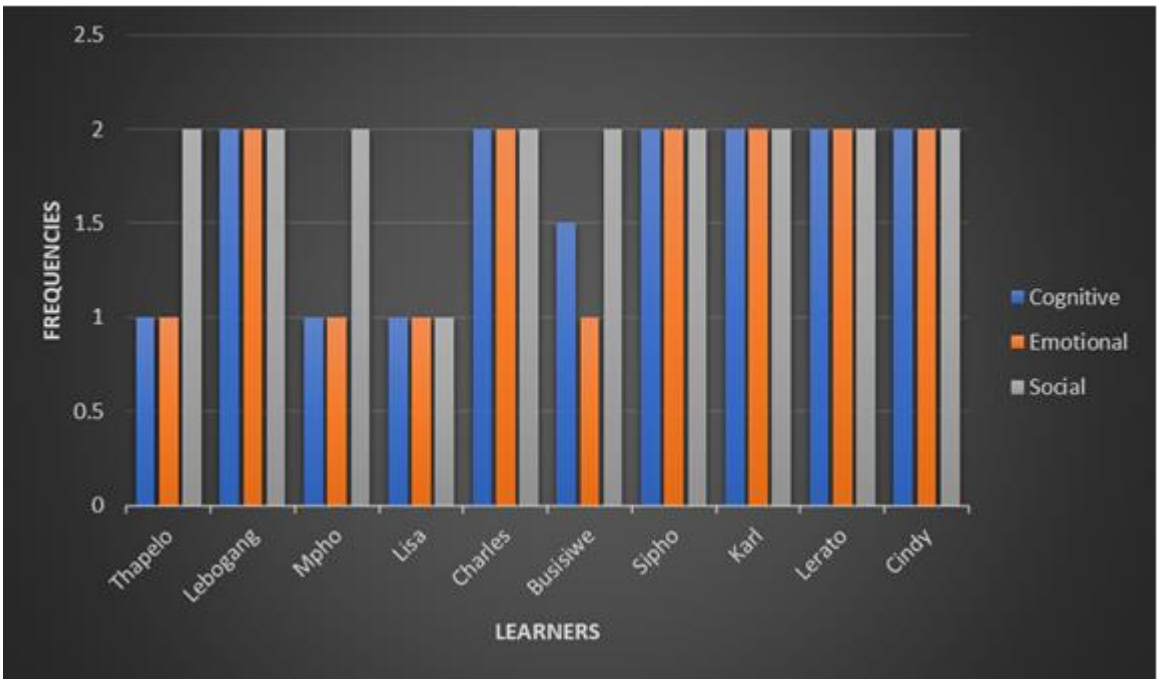


Figure 20: Summary of the ten profiles of mindsets within Illeris's dimensions of learning

In light of the analysis of findings based on the ten learners, for the high achievers, the chart indicates that Sipho, Karl, Lerato and Cindy demonstrated a similar pattern: all of them are growth mindset in the cognitive, emotional and social dimensions. This indicates that learners who are high achieving do have a better sense of themselves, cognitively. They also feel more emotionally confident and they utilise the social support that may be needed. The only case that is not as typical as that is Busisiwe (learner 10), who is low in terms of emotional dimension (i.e. she is fixed within the emotional dimension). This learner does not feel emotionally confident, although she is a high achiever. More so, Busisiwe shows growth in terms of the cognitive and social dimensions.

Among the learners who are low achievers, the chart indicates that Lebogang, Mpho and Charles showed similar pattern of mindsets across the three dimensions of learning: fixed across cognitive and emotional and growth within social dimension. Interestingly, Lisa

(Learner 3) is a unique and classic case among the low achievers, as well as across all the ten learners, because she has a fixed mindset in terms of the cognitive, emotional and social dimensions.

Generally, drawing on the analysis of findings given the ten learners, the cognitive, emotional and social dimensions seem to be responsible for influencing the learners' learning, leading to their achievements in the subject. It is crucial to note that achievement does not infer that all the dimensions must be positive at all times in the learning process. Some dimensions may seem to constrain learning, yet a learner still performs well; and some dimensions may seem to afford learning, yet a learner still performs poorly. As such, there is an influence of mindset on the learners' achievement, which is located in the cognitive, emotional and social dimensions in the learning process.

6.5 Summary

In this chapter, I have realised that the learners have internalised mindsets, beliefs and attitudes. To this end, I am inclined to agree with Dweck (2013c), Carey (2012) and Vermeer's (2012b) notion that mindsets influence attitudes towards mathematics and its learning. These learners' mindsets (fixed and growth) are socially constructed. Learners' attitudes are socially constructed as well.

Learners' attitudes are a result of what they have experienced in mathematics and its learning. Following this, I agree with Boaler, William and Zevenbergen (2000) that low and high achievements of learners in mathematics and its learning are attributed to, and influenced primarily by, the learners' beliefs, attitudes and perceptions. These are not something innate; they are socially constructed.

More so, I found that learners' mindsets have various consequences for their learning, such as the growth mindset affords learning and leads to success in learning and the fixed mindset tends to constrain learning and fundamentally leads to failure in learning (Tirri & Kujala, 2016; Dweck, 2006a; Dweck, 2006b).

Bringing the ten learners (five low achievers and five high achievers) as a cluster, none of the high achievers were in fixed mindsets on the cognitive dimension, i.e. none of the high achievers have a fixed mindset that is more predominant, or complete in the cognitive dimension. The emotional fixed mindset could be more, but the learner(s) with such qualities can still perform well (high achiever) in as SFSCS like mathematics. More so, the social dimension is very substantial in the learning process of an SFSCS like mathematics. Specifically, social support is the dominant category of the social dimension, as well as compared to every category, because it is constantly noted that it enhances learning.

Following the analysis of findings, achievement does not infer that all the dimensions must be positive at all times in the learning process. In this light, the cognitive, emotional and social dimensions seem to be responsible for influencing the learners' learning and leading to achievements or performances in the learning process. There is influence of mindset on their achievement, which is located in the cognitive, emotional and social dimensions in the learning process.

I now proceed to the next chapter: parents' and teachers' perceptions of learners' mindsets and their influence on learning.

CHAPTER 7

PARENTS' AND TEACHERS' PERCEPTIONS OF LEARNERS' MINDSETS AND THEIR INFLUENCE ON LEARNING

7.1 Introduction

I have explicitly exemplified how I conceptualised mindsets within Illeris's three dimensions of learning, which constituted the analytical framework for this study. This was accomplished by bringing together the theoretical field and empirical field. The concern of Chapter 7 is to present findings and discussions on the teachers' and parents' perceptions of learners' mindsets and their influence on learning, through the analysis of three mathematics teachers' interviews and ten learners' parents' questionnaires. Hence, this chapter only focuses on data collected from the learners' mathematics teachers and their parents.

The results for the teachers and parents were firstly organised into two broad categories, such as learners' mathematics teachers and learners' parents. Thereafter, a case of each teacher and parent is presented with further categorisation into two critical categories: growth mindset and fixed mindset, under each of the dimensions: cognitive dimension, emotional dimension and social dimension. All these were guided by the analytical framework. Furthermore, summaries of findings across the mathematics teachers and learners' parents' responses are presented and the synthesis across all the teachers' and parents' case studies is equally presented. Finally, the summary of this chapter is presented.

7.2 Mathematics teachers

As mentioned in Chapter 4, three mathematics teachers of the ten learners selected for this study were also involved and participated in this study. These teachers are: Teacher 1 (Mr Vuyo) has a Bachelor of Science (B.Sc.) in Mechanical Engineering, with a specialisation in Aeronautical Engineering. He teaches mathematics and physical sciences. Teacher 2 (Mrs Thando) has a Diploma in Mathematics, as well as a Bachelor of Science (B.Sc.) in mathematics and applied mathematics. She teaches mathematics. Teacher 3 (Mr Kabelo) has a Bachelor of Science (B.Sc.) in Electrical Engineering and a PGCE (Post Graduate Certificate in Education). He teaches mathematics and sciences. I, therefore, examine each of the teachers in detail by exploring the influences of their inferred perceptions of mindsets toward the learning of an SFSCS, like mathematics. A case study of each of the three teachers is subsequently given below. I present findings for each according to Illeris's three dimensions of learning and Dweck's two types of mindsets, as well as discuss the influence of each on the learning of subjects like mathematics.

7.2.1 A case of Mr Vuyo

Mr Vuyo is the mathematics teacher, who teaches Karl, Lisa, Lebogang, Lerato and Cindy. Figure 21 and Table 26 present summaries of the findings of the interview with Mr Vuyo.

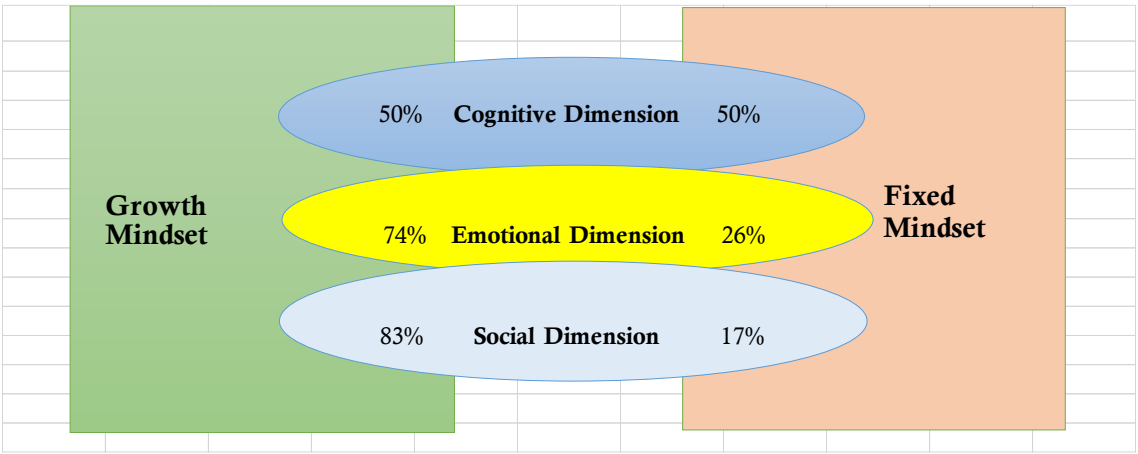


Figure 21: Summary of Mr Vuyo's profile of mindsets within Illeris's dimensions of learning

Figure 21 shows Mr Vuyo's frequencies of responses with 50% of the responses within the cognitive growth mindset; 50% within the cognitive fixed mindset, at the cognitive level; 74% within the emotional growth mindset; 26% within the emotional fixed mindset, at the emotional level; 83% of the responses within the social growth mindset; and 17% within the social fixed mindset, at the social level.

Below is a table presenting further details of Mr Vuyo's case, which itemises the categories with their corresponding frequencies within their dimensions respectively, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 26: Summary of Mr Vuyo categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	4/8 (50% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	4/8 (50% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	14/19 (74% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	5/19 (26% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	20/24 (83% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	4/24 (17% of all categories in the social dimension fixed mindset)

On the cognitive level, Table 26 indicated that Mr Vuyo's utterances have the same frequency of incidents at the cognitive dimension: cognitive fixed mindset and cognitive growth mindset constitute 50% each of all the incidents. The most frequent utterances (4 incidents) are a belief that mathematics intelligent people are born with it rather than acquire it through learning, hard work and perseverance. This category is within the cognitive fixed mindset. On the other hand, it can be noted that Mr Vuyo, in 4 incidents, values or shows the use of mathematics

learning as well [i.e. equally the most frequent utterances]. This category is within the cognitive growth mindset.

Within the emotional dimension, Mr Vuyo's utterances were predominantly emotional growth mindset (74%), with perceptions in 8 incidents that mathematics learning requires practice and perseverance. In two incidents, Mr Vuyo perceives that learners feel excited when learning mathematics, they (learners) are confident in learning mathematics (3 incidents) and competent when learning mathematics (1 incident). On the other hand, Mr Vuyo also acknowledged, in 4 incidents, the learners' laissez-faire attitude towards learning mathematics and learning with inadequateness (1 incident). These two categories are within the emotional fixed mindset.

In the social dimension, Mr Vuyo's utterances were predominantly social growth mindset (83%), believing that learning mathematics requires support (12 incidents). Also within the social growth mindset, Mr Vuyo, in 3 incidents, believes that learners' attributes are inconsequential in learning mathematics and, in 5 incidents, responded about learning through participation. On the other hand, Mr Vuyo also acknowledged (in 2 incidents) that learners' attribute influences learning and he also indicated learners' non-participation in class (1 incident). These two categories are within the social fixed mindset.

Generally, Mr Vuyo's utterances during the interview were the same in both growth mindset and fixed mindset within the cognitive dimension, and predominantly growth mindset within the emotional and social dimensions, in terms of his perceptions of the learners' mindsets toward mathematics learning. In the next section, I provide a qualitative analysis of selected predominant extracts within the three dimensions of learning.

7.2.1.1 Mr Vuyo's cognitive growth and fixed mindsets

As indicated in Table 26, Mr Vuyo's utterances in the interview regarding the cognitive dimension were similar in terms of the two mindsets: growth and fixed mindsets. For the cognitive growth mindset, one of the categories exemplified here was Mr Vuyo's views about the usefulness and importance of learning mathematics. This is classified within the cognitive growth mindset. Below, I provide evidence from the interview extracts to support this point.

Interviewer:	Do you enjoy and interested in teaching mathematics?
Mr Vuyo:	Yes, I enjoy teaching mathematics. I enjoy building people up and mathematics is a weapon to build the learners up. So, mathematics helps the learners to apply what they can use in the future. As such, it makes me teach science to them. So, I enjoy teaching mathematics. In terms of being interested in teaching mathematics, I will forever teach mathematics. I started teaching mathematics when I was in grade 8 – I started teaching my peers. So, I am very interested in teaching mathematics.
Interviewer:	Do the learners say that it (mathematics) is useful or a waste of time?
Mr Vuyo:	The learners say mathematics is useful.
Interviewer:	Please explain.
Mr Vuyo:	The learners say mathematics is useful because of the inspirations they have now, they see the importance. They even say they want to do pure mathematics. So, they can see and know the use of mathematics.
Interviewer:	What do you think about the learners' beliefs towards mathematics learning?
Mr Vuyo:	Emmm I want to groom scientists from them. I always tell them about universities. I tell them about different careers that mathematics can help them in. They want to be at Wits because I am a graduate of Wits [smiles]. They want to be part of the science disciplines - I think, that is, about 60% of them. So, most of the learners' belief is that mathematics is compulsory and important to them.

The above extracts by Mr Vuyo depict that learning mathematics is essential and valuable, as well as a tool for developing learners. It is applicable in other subjects and future career choices, since mathematics is relevant in all spheres of life. These extracts are linked with a growth mindset, as they afford learning. The literature suggests that a learner applies his/her

knowledge of mathematics to related subjects in the learning process (Obomanu & Adaramola, 2011; Reyes & Stanic, 1998).

Regarding the cognitive fixed mindset, one of the categories exemplified here was tha Mr Vuyo showed a strong belief that some learners are born smart in learning mathematics, i.e. mathematics learning is innate (inborn). This is classified within the cognitive fixed mindset. Below, I provide evidence from the interview extracts to support this point.

Interviewer:	Are learners born with a special talent in mathematics?
Mr Vuyo:	Yes, I think so yes! Learners are born with a special talent in mathematics.
Interviewer:	Please explain.
Mr Vuyo:	Learners are born with a special talent in mathematics. Emmm I will be very scriptural on this part. When you look at the book of Exodus. God speaks to Moses. He says, you are not to build the tabernacle for me; for I have assigned the people and I gave them skills to build it. So, in other words, God does give some persons certain skills to specialize in so that we do not have a deficiency in some particular field or disciplines at all. As such, some learners with a special talent or skills in mathematics.
Interviewer:	Does race influence intelligence?
Mr Vuyo:	Emmm it is something difficult that I am battling with as an individual. If someone is smarter, I do not look at race. I just look at that person as gifted.
Interviewer:	So, can we say that a learner can be gifted in mathematics learning?
Mr Vuyo:	Yes, a learner can be gifted in mathematics learning because if a footballer can be gifted a soccer player, then a learner can be gifted with skills in mathematics learning as well.

The above extracts by Mr Vuyo depict that he strongly believes that some learners are born with the gift or intelligence to learn mathematics effectively. This belief is a pointer to a fixed mindset and may have an impact on the learning of the subject. The literature suggests that this belief has negative impacts on the learners (Haimovitz & Dweck, 2017; Boaler, 2013).

7.2.1.2 Mr Vuyo's emotional growth mindset

As indicated in Table 26, Mr Vuyo's utterances in the interview concerning the emotional dimension were predominantly a growth mindset. One of the categories exemplified here was Mr Vuyo's points about learning mathematics through practice and perseverance. This is classified within the emotional growth mindset. Below, I provide evidence from the interview extracts to support this point.

Interviewer:	Are the learners committed to mathematics learning?
Mr Vuyo:	The learners are committed to mathematics learning.
Interviewer:	Please explain.
Mr Vuyo:	The learners are committed to mathematics learning because if you can check the attendance, it is not bad because they are determined to learn.
Interviewer:	What happens when the learners get stuck in mathematics problems?
Mr Vuyo:	When the learners get stuck in mathematics problems, some of them either go and ask someone who is smart in the class, or I go and help.
Interviewer:	How do the learners handle difficult problems in mathematics?
Mr Vuyo:	When the learners are doing difficult problems in mathematics, some of them make use of the method(s) I taught them.
Interviewer:	Do they continue trying, i.e., persist?
Mr Vuyo:	As I said, some of the learners persist - continue trying by applying the methods they were taught.

The above extracts by Mr Vuyo depict that some learners read and practise mathematics as they are committed to enable them to have more good knowledge about the subject. More so, some of the learners do not quit when they are faced with challenges when solving mathematics problems. These are associated with learners who hold a growth mindset and they afford success in the learning of the subject, since putting more effort and perseverance enhances learners in the learning process (Haimovitz & Dweck, 2017).

7.2.1.3 Mr Vuyo's social growth mindset

As indicated in Table 26, Mr Vuyo's utterances in the interview concerning the social dimension were predominantly a growth mindset. One of the categories exemplified here was Mr Vuyo's views on the social support that his learners get whenever they need or seek support from him (teacher), family members and peers. This is classified within the social growth mindset. Below, I provide evidence from the interview extracts to support this point.

Interviewer:	How do the learners relate with each other during mathematics learning?
Mr Vuyo:	In terms of the learners relating with each other during mathematics learning – some of the learners relate with each other. Emmm 20% of the learners are working as a group.
Interviewer:	What about helping each other?
Mr Vuyo:	We are not doing too much group work. Remember our annual teaching for this term is too much already. So, we are trying to get the most work done as possible. So, I have learners, like four or five who are very smart. I ask those smart learners to help those other learners who do not understand. So, this is peer teaching again.
Interviewer:	What happens when the learners get stuck in mathematics problems?
Mr Vuyo:	When the learners get stuck in mathematics problems, some of them either go and ask someone who is smart in the class, or I go and help. But at times I cannot get to all of them. I usually say to them, come at the break period. One thing I have done last year was that I called a boy in grade 11 who is very good at mathematics and relates very with them by helping. Actually, I have two smart boys in mathematics in grade 11 who I normally call to come and help them; so that they (learners) can have different tastes of teachers. Sometimes, I call the learners that I have taught to come and help them.
Interviewer:	Do any of the learners' family members give you support/assistance regarding the learning of mathematics of their child(ren) whenever the need arises?
Mr Vuyo:	Yes, they do, they do - my learners' family members give me support or assistance regarding the learning of mathematics of their children because emmm most learners' parents would call and ask me, Mr Vuyo, what should I do with my child? I will say, help with their homework. For the fact that they call me, I feel that is a support. More so, when I call the learners' parents for their support, they do. They bring the learners here for extra classes on Saturdays.

Mr Vuyo's extracts depict that his learners get the amount of support they need in mathematics and its learning at home from their parents (family members), as well as the support they need from their peers and mathematics teacher at school. These are associated with a growth mindset and they afford learning of the subject. The literature suggests that, when learners are provided with the necessary support for effective learning of the subject, they achieve more in the learning process (Martin, 2006; Reyes & Stanic, 1998).

7.2.2 A case of Mrs Thando

Mrs Thando is Busisiwe, Sipho and Mpho's mathematics teacher. Figure 22 and Table 27 present summary of the findings of the interview with Mrs Thando.

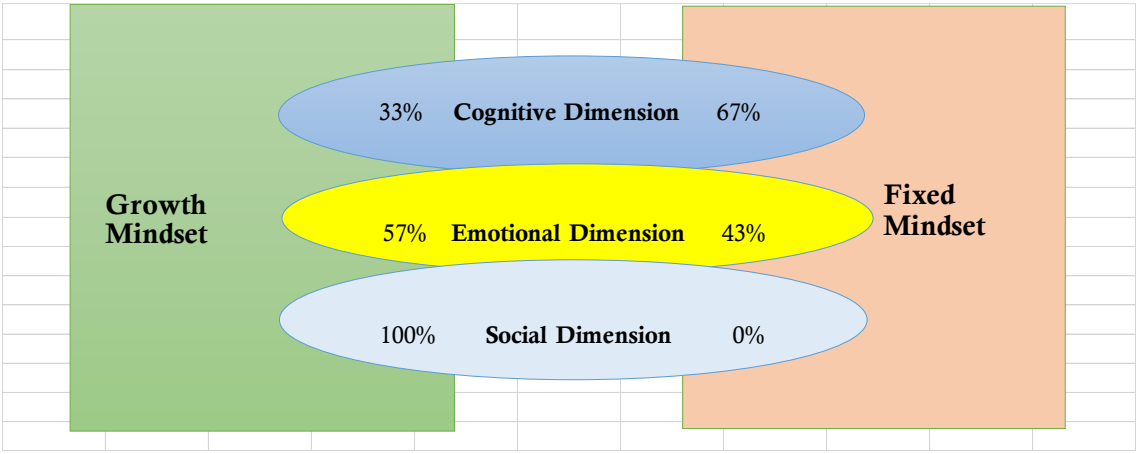


Figure 22: Summary of Mrs Thando's profile of mindsets within Illeris's dimensions of learning

Figure 22 shows Mrs Thando's frequencies of responses in terms of the two distinct kinds of mindsets (growth mindset and fixed mindset) represented with 33% of the responses within the cognitive growth mindset; 67% within the cognitive fixed mindset, at the cognitive level; 57% within the emotional growth mindset; 43% within the emotional fixed mindset, at the emotional level; 100% within the social growth mindset; and 0% within the social fixed mindset, at the social level.

Below is a table presenting further details of Mrs Thando's case, by itemising the categories with their corresponding frequencies within their dimensions respectively, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 27: Summary of Mrs Thando categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	1/3 (33% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	2/3 (67% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	16/28 (57% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	12/28 (43% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	13/13 (100% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	0/13 (0% of all categories in the social dimension fixed mindset)

On the cognitive level, Table 27 indicated that Mrs Thando's utterances were predominantly cognitive fixed mindset, constituting 67% of all incidents with the most frequent (1 incident) utterances of a belief that mathematics intelligent people are born with it, rather than acquiring

it through learning, hard work and perseverance. She also views errors as setbacks in mathematics learning (1 incident). However, it can be noted that Mrs Thando values mathematics learning (1 incident). This category is within the cognitive growth mindset.

Within the emotional dimension, Mrs Thando's utterances were more emotional fixed mindset (57%), with perceptions (in 7 incidents) of her learners' laissez-faire attitude towards mathematics learning. Mrs Thando also perceived that her learners felt bored when learning mathematics (3 incidents), as well as learn the subject with uncertainty (2 incidents). However, Mrs Thando lso acknowledged (in 7 incidents) that mathematics learning requires practice and perseverance. More so, Mrs Thando (in 5 incidents) perceives that her learners feel excited when learning mathematics, they (learners) are confident in learning mathematics (3 incidents), as well as competent when learning mathematics (1 incident). These three categories are within the emotional growth mindset.

On the social dimension, Mrs Thando's utterances were completely social growth mindset (100%), believing that learners' attributes are inconsequential in learning mathematics (7 incidents), participation is critical in learning mathematics (3 incidents) and learning mathematics requires support (3 incidents).

Overall, Mrs Thando's utterances during the interview were predominantly growth fixed mindset within cognitive dimension, more growth mindset within emotional dimension and completely growth mindset within the social dimension. In the next section, I provide a qualitative analysis of selected predominant extracts within the three dimensions of learning.

7.2.2.1 Mrs Thando's cognitive fixed mindset

As indicated in Table 27, Mrs Thando's utterances in the interview regarding the cognitive dimension were predominantly fixed mindset. One of the categories demonstrated here was that Mrs Thando displayed a strong belief that some learners are born smart in learning mathematics, i.e. that is mathematics learning is innate (inborn). This is grouped within the cognitive fixed mindset. The excerpt below exemplifies this finding.

> Interviewer: Are learners are born with a 'special' talent in mathematics?
>
> Mrs Thando: In my years of teaching mathematics, intuitively one or two learners will just give you a great answer to a mathematics problem. They see the pattern before you even explain anything. As such, some learners are 'special'. So, yes! there are learners that are born with a special talent in mathematics.

Mrs Thando's above excerpt shows that she strongly believes that some learners are born with the talent, or intelligence, to learn mathematics effectively This belief is a pointer to a fixed mindset and may have consequences for the learning of the subject, as the literature suggests that this belief has a negative implication on the learners in the learning process of the subjects (Zhang, Kuusisto & Tirri, 2017; Boaler, 2013; Dweck, 2006a).

7.2.2.2 Mrs Thando's emotional fixed mindset

As indicated in Table 27, Mrs Thando's utterances in the interview concerning the emotional dimension were more fixed mindset. One of the categories demonstrated here was Mrs Thando's statements about her learners' laissez-faire attitude towards mathematics learning. This is grouped within the emotional fixed mindset. The excerpts below exemplify this finding.

> Interviewer: Do the learners concentrate/pay attention in the class?

Mrs Thando: Their (learners) level of maturity, grade 9 is very low - when you tell them, take out your mathematics, what, what and what; they (learners) will not pay attention.

Interviewer: Please tell me what type of mathematics learners they are.

Mrs Thando: Another type is the lazy learners of mathematics - they are just tired all the time; they do not even struggle to learn mathematics. It is a struggle for them to take up their mathematics textbooks. You have to force them and say, take out your books, write this and do this. You see, it is not a surprise for me to find learners in this category behave this way – that is, they do not do what you ask them to do.

Interviewer: Are they committed to mathematics learning?

Mrs Thando: It is only a few learners who are committed to mathematics learning [laughs].

Interviewer: Please explain.

Mrs Thando: It is only a few learners who are committed to mathematics learning because to some of them, it is like they are paid to come and learn mathematics [laughs]. The learners do not show that commitment to mathematics learning – this affects their effective learning of mathematics.

Interviewer: If they made a mistake, what is their reaction(s)?

Mrs Thando: Most of the learners rejoice over making a mistake; and they say yooh, we made a mistake. But without making any attempt to correct and know it [smiles].

Interviewer: Do they complete their mathematics tasks?

Mrs Thando: Most learners do not complete theirs.

Interviewer: What do you think about the learners' beliefs towards mathematics learning?

Mrs Thando: The learners believe that mathematics is a big challenge and it is like a no-go area of learning.

The above excerpts show the disposition of lack of determination and perseverance in learning mathematics by most of Mrs Thando's learners. Simply put, most of Mrs Thando's learners do not persist when stuck in a mathematics problem – they are not committed and quit when confronted with challenges in mathematics learning. These dispositions are indications of learners with a fixed mindset, which constrains learning and leads to failure in

the subject. The literature suggests that learners with a fixed mindset do not persist when they find mathematics problems or exercises difficult (Haimovitz & Dweck, 2017; Boaler, 2013).

7.2.2.3 Mrs Thando's social growth mindset

As indicated in Table 27, Mrs Thando's utterances in the interview concerning the social dimension were completely a growth mindset. One of the categories demonstrated here was Mrs Thando's views that learners' attributes do not influence their mathematics learning. This is grouped within the social growth mindset. The excerpts below exemplify this finding.

Interviewer:	Do males and females learn differently?
Mrs Thando:	No ooo, males and females do not learn mathematics differently [laughs].
Interviewer:	Are males naturally better in mathematics than females?
Mrs Thando:	No ooo, males are not naturally better in mathematics than females.
Interviewer:	Why no ooo?
Mrs Thando:	Males are not naturally better in mathematics than females because they are just the same. You know, in terms of gender in mathematics learning, kids (learners) are the same. You know what? The only thing is that it depends on their responsibilities and what they want to do and whether they (learners) are willing and interested to do it (mathematics).
Interviewer:	Does race influence intelligence?
Mrs Thando:	No, race does not influence intelligence in mathematics.
Interviewer:	Please explain why.
Mrs Thando:	Race does not influence intelligence in mathematics, but it only influences your emmm being responsible. There are those who are groomed because they are responsible. So, they know that they need to do their mathematics work, okay? In all, race does not influence intelligence in mathematics. It is all about your behaviour and approach to mathematics learning.
Interviewer:	Do you consider race as an attribute to effective learning of mathematics?
Mrs Thando:	No, not really. I do not consider race as an attribute to effective learning of mathematics.
Interviewer:	Explain why.

Mrs Thando: Not really, I do not consider race as an attribute to effective learning of mathematics because race only affects behaviour.

Mrs Thando's excerpts show her perception that learners' attributes, learners' level of capability in mathematics and its learning are not linked to race and gender. Having good knowledge of the subject, for her is not a function of one's attributes: race and gender. This is an indication of a growth mindset toward learning, which enhances effective learning. Literature suggests that learning is not influenced by learners' race and gender, which do not prevent learners from having the capabilities to learn effectively. Racial and gender differences in mathematics and its learning only exist among learners who hold a fixed mindset. Invariably, gender differences in learning do not exist among learners who hold a growth mindset (Haimovitz & Dweck, 2017; Boaler, 2013; Martin, 2006; Nasir & Hand, 2006; Skovsmose, 2005; Reyes & Stanic, 1998).

7.2.3 A case of Mr Kabelo

Mr Kabelo is Thapelo's and Charles's mathematics teacher. Figure 23 and Table 28 present summaries of the findings of the interview with Mr Kabelo.

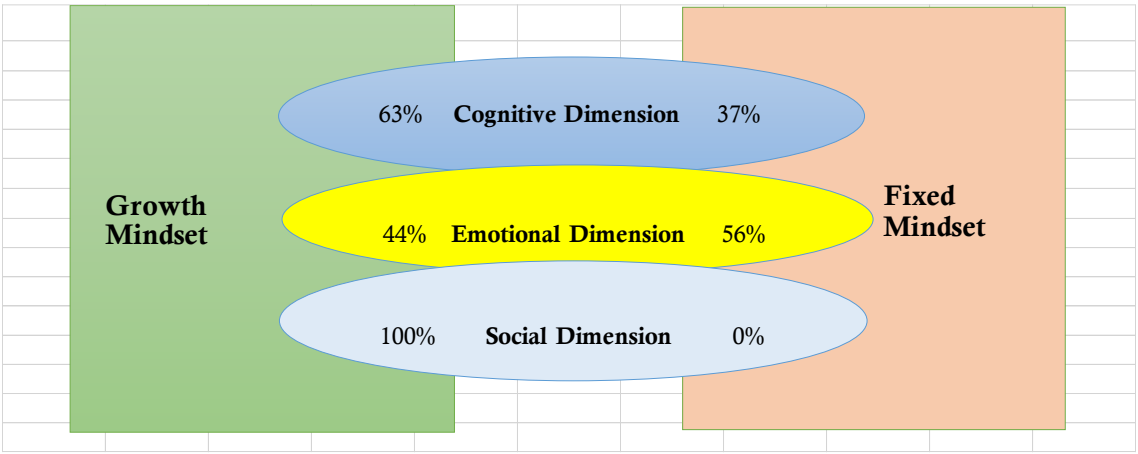


Figure 23: Summary of Mr Kabelo's profile of mindsets within Illeris's dimensions of learning

Figure 23 shows Mr Kabelo's frequencies of responses in terms of the two distinct kinds of mindsets (growth mindset and fixed mindset), with 63% of the responses within the cognitive growth mindset; 37% within the cognitive fixed mindset, at the cognitive level; 44% within the emotional growth mindset; 56% within the emotional fixed mindset, at the emotional level; 100% within the social growth mindset; and 0% within the social fixed mindset, at the social level.

Below is a table presenting further details of Mr Kabelo's case, itemising the categories with their corresponding frequencies within their dimensions respectively, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 28: Summary of Mr Kabelo categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	5/8 (63% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	3/8 (37% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	17/39 (44% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	22/39 (56% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	15/15 (100% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	0/15 (0% of all categories in the social dimension fixed mindset)

On the cognitive level, Table 28 indicated that Mr Kabelo's utterances were predominantly cognitive growth mindset, constituting 63% of all incidents, with the most frequent utterances (3 incidents) of a belief that mathematics intelligent people are not born with it, but acquire it through learning, hard work and perseverance, as well as views that mathematics learning is valuable, useful and important (2 incidents). Conversely, Mr Kabelo noted in 2 incidents that mathematics intelligent people are born with it, rather than acquiring it through learning, hard

work and perseverance. He also mentioned, in 1 incident, that his learners view committing errors as a setback in learning. These two categories are within the cognitive fixed mindset.

Within the emotional dimension, Mr Kabelo's utterances were more emotional fixed mindset (56%), with perceptions in 17 incidents of his learners' laissez-faire attitude towards mathematics learning. Mr Kabelo also perceived that his learners felt bored when learning mathematics (4 incidents) and learn the subject inadequately (1 incident). Conversely, Mr Kabelo acknowledged, in 7 incidents, that mathematics learning requires practice and perseverance. More so, in 6 incidents, Mr Kabelo perceived that his learners fltl excited when learning mathematics. They (learners) were confident in learning mathematics (2 incidents), as well as competent when learning mathematics (2 incidents). These three categories are within the emotional growth mindset.

In the social dimension, Mr Kabelo's utterances were completely social growth mindset (100%), noting that learning mathematics requires support (7 incidents), learners' attribute is inconsequential in learning mathematics (6 incidents) and participation is critical in learning mathematics (2 incidents).

Generally, Mr Kabelo's utterances during the interview were predominantly growth mindset within the cognitive dimension, more fixed mindset within the emotional dimension and completely growth mindset within the social dimension. In the next section, I provide a qualitative analysis of selected predominant abstracts within the three dimensions of learning.

7.2.3.1 Mr Kabelo's cognitive growth mindset

As indicated in Table 28, Mr Kabelo's utterances in the interview regarding the cognitive dimension were predominantly a growth mindset. One of the categories illustrated here was

that Mr Kabelo displayed a strong belief that learners are not born smart in learning mathematics - that is mathematics learning is not innate (inborn). This is classified within the cognitive growth mindset. The extracts below demonstrate this finding.

Interviewer: Are learners are born with a special talent in mathematics?

Mr Kabelo: I do not think that learners are born with a special talent in mathematics.

Interviewer: Explain, please.

Mr Kabelo: I do not think that learners are born with a special talent in mathematics because I have witnessed learners who were struggling in mathematics in grade 8, grade 9 and grade 10; something happened, when the learners got to grade 11, some motivations occurred from I do not know where and the learners became good [smiles]. But I believe everybody has the ability to find somehow within themselves and 'unlynch' that mathematical potentials. You can learn to become a good mathematician.

Interviewer: What are the attitudes of your learners toward mathematics learning?

Mr Kabelo: Emmm my learners' attitudes toward mathematics learning. Yeah, I do not know how to put it [smiles]. Nevertheless, I will emphasise that no learner is born with mathematics intelligence because a learner needs the interest, determination and courage to be good at mathematics. So, it is the attitude toward mathematics learning that determined if the learner will be good or not.

The selection above indicates that Mr Kabelo believes that learners are not born with the intelligence of mathematics to learn it well. That is, no learner is born with special talent - knowledge and understanding to learn mathematics effectively. In other words, being knowledgeable in mathematics and its learning is not inborn (innate). These beliefs are a pointer to a growth mindset and they afford learning of the subject. Literature suggests that these positive beliefs afford success in learning the subjects: learners believe that intelligence and smartness are not innate and can be learned. This is evident in how learners engage with their learning, as mindsets have a vital role in learning, because a learner's mindset affects his/her learning (Haimovitz & Dweck, 2017; Boaler, 2013).

7.2.3.2 Mr Kabelo's emotional fixed mindset

As indicated in Table 28, Mr Kabelo's utterances in the interview concerning the emotional dimension were more fixed mindset. One of the categories illustrated here was Mr Kabelo pointing go his learners' laissez-faire attitude towards mathematics learning. This is classified within the emotional fixed mindset. The abstracts below demonstrate this finding.

Interviewer:	What happens when the learners get stuck in mathematics problems?
Mr Kabelo:	I do tell the learners when I am teaching and they do not understand or when they are stuck, they should raise their hand and ask me questions. But I have noticed that some of the learners do not always raise their hand despite the instruction I gave them on that.
Interviewer:	How do the learners handle difficult problems in mathematics?
Mr Kabelo:	The learners do not handle difficult mathematics problems. What the learners do when they come across difficult problems in mathematics is that they just give up on it. In fact, the majority of the learners just give up on difficult mathematics problems when they are stuck.
Interviewer:	Do they continue trying?
Mr Kabelo:	Like I earlier mentioned, most of the learners do not continue trying when in a difficult situation in solving mathematics problems.
Interviewer:	Please explain.
Mr Kabelo:	Some learners give up and wait for me to assist them; that is if they ask me to do that. Some of them give up because they just do not want to continue.
Interviewer:	Do they ask for help?
Mr Kabelo:	The majority of the learners do not ask for help when stuck.
Interviewer:	Please explain.
Mr Kabelo:	The majority of the learners do not ask for help when stuck because they do not want to stress themselves in mathematics learning at all.
Interviewer:	Do the learners concentrate/pay attention in the class?
Mr Kabelo:	I have noticed something: emmm it is not 100% of the learners who are always focusing. Sometimes after a break, you find some of the learners that are tired. Emmm we do not know what they are eating during the break period(s) [smiles]. Some learners are usually very tired and lazy to the extent

that they do not want to study, they are not determined anymore; so, they no longer pay attention to what I am teaching and avoid solving mathematics problems [smiles] - especially during the last periods. This is a challenge; and a contributing factor that we neglect because it seriously affecting their studies.

Interviewer: What do you think about the learners' beliefs towards mathematics learning?

Mr Kabelo: Emmm some parents, teachers and others have created the perception that mathematics is complex and challenging and the learners also have to believe them. That is why they, learners are not interested and willing in a mathematics lesson. They do not even want to participate in the mathematics lessons. Always not contributing or say anything in the classroom.

The above extracts by Mr Kabelo show that some learners exhibit the dispositions of laziness and tiredness when learning, as well as a lack of determination in mathematics learning. These are indications of a fixed mindset and they constrain learning of the subject, as the literature suggests that a learner who holds a fixed mindset prefers to do easier tasks, as he/she does not want to put in more effort and/or persist in learning the subject (Haimovitz & Dweck, 2017; Boaler, 2013).

7.2.3.3 Mr Kabelo's social growth mindset

As indicated in Table 28, Mr Kabelo's utterances in the interview concerning the social dimension were predominantly growth mindset. One of the categories illustrated here was Mr Kabelo's views on the social support that his learners get whenever they need, or seek support from him (teacher), family members and peers. This is classified within the social growth mindset. The extracts below demonstrate this finding.

Interviewer: How do the learners relate with each other during mathematics learning?

Mr Kabelo: When the learners are given an opportunity to work with each other as a strategy that is intended to encourage peer learning, they relate with each other well. The learners also assist each other after sessions (official classes).

Interviewer: What about helping each other?

Mr Kabelo: If one learner does not understand, the one next to him/her assists.

Interviewer: What happens when the learners get stuck in mathematics problems?

Mr Kabelo: I do tell the learners when I am teaching and they do not understand or when they are stuck, they should raise their hand and ask me questions.

Interviewer: Are you motivated in teaching mathematics?

Mr Kabelo: Yes, I am absolutely motivated in teaching mathematics.

Interviewer: Do you entertain questions from the learners in the class?

Mr Kabelo: Yes, I entertain questions all the time from the learners in the class. The learners must always ask 'why'. I call it the 'y – regress' – though I miss use it, it means to me that the learners keep asking me 'why' all the time. Hence, I call it y – regress [smiles]. They do ask a lot of questions. However, when they (learners) do not ask me questions, I ask them.

Interviewer: Can you tell me about the learners' performances in mathematics?

Mr Kabelo: Yes, the majority of the learners are average in terms of their performances in mathematics.

Interviewer: How will you rate the learners' performances in mathematics?

Mr Kabelo: I will rate the learners, emmm just average.

Interviewer: Please explain.

Mr Kabelo: The learners are average in mathematics learning. However, the learners are developing. In mathematics learning generally, most of the learners are struggling. You should know that even research has confirmed that (most learners are struggling in mathematics learning). Although, the learners' guidance and putting their best or effort to ensure that their children are good at mathematics [smiles].

Mr Kabelo's extracts infer that his learners get the amount of support they need in mathematics and its learning at home from their parents (family members), as well as the support they need from their peers and mathematics teacher at school. These are associated with a growth mindset and they afford learning of the subject. The literature suggests that when learners are given the needed support to learn the subject effectively, they achieve more (Nasir & Hand, 2006).

7.2.4 Summary of findings across the teachers

As previously mentioned, there are three mathematics teachers of the ten learners presented in Chapter 4: Mr Vuyo, Mrs Thando and Mr Kabelo. Each of the teachers was examined in detail by exploring the influences of their inferred perceptions of mindsets toward the learning of an SFSCS like mathematics. Table 29 presents a comparison of the findings of the interviews with the three mathematics teachers.

Table 29: Comparison of teachers categorisation of mindsets within Illeris's dimensions of learning

Teachers	Cognitive Dimension	Emotional Dimension	Social Dimension
Mr Vuyo	Mr Vuyo had the same number of utterances in the cognitive dimension; i.e., each of the cognitive fixed mindset and cognitive growth mindset constitutes equal number of all the incidents.	Mr Vuyo's utterances were predominantly emotional growth mindset.	Mr Vuyo's utterances were predominantly social growth mindset.
Mrs Thando	Mrs Thando's utterances were predominantly cognitive fixed mindset.	Mrs Thando's utterances were more emotional fixed mindset.	Mrs Thando's utterances were completely (all) social growth mindset.
Mr Kabelo	Mr Kabelo's utterances were predominantly cognitive growth mindset.	Mr Kabelo's utterances were more emotional fixed mindset.	Mr Kabelo's utterances were completely (all) social growth mindset.

A brief analysis of Table 29 is as follows. The three teachers are the ten learners' mathematics teachers. It is worth noting that the table (Table 29) presents a comparison of the findings of the interviews with the three mathematics teachers at a glance.

In light of the analysis of findings on the basis of the three teachers, the social dimension is very critical for positive achievement or good performance in the learning process. In Table 29, the social growth dimension is consistently more in terms of the number of utterances from the teachers. That is, the teachers' utterances were predominantly or completely (all) social growth mindset at the social level, whereas, at the emotional level, two teachers' (Mrs Thando's and Mr Kabelo) utterances were more emotional fixed mindset. However, Mr Vuyo's utterances were predominantly emotional growth mindset at the emotional level. While at the cognitive level, Mr Vuyo had a balanced number of utterances in terms of the growth and fixed mindset. Mrs Thando's utterances were predominantly cognitive fixed mindset and Mr Kabelo's utterances were predominantly cognitive growth mindset.

Drawing from the above, the social dimension seems very central of all the dimensions. That is, the social dimension seems very crucial, when compared to the cognitive and emotional dimensions. More so, none of the teachers are completely (100%) growth mindset or fixed mindset.

7.3 Learners' parents

It is worthy of note that, for the learners and teachers, I collected interviews to code according to the analytical framework. The same method is applied to the learners' parents' questionnaires. As mentioned in Chapter 4, the questionnaires gave more data, because the learners' parents gave information about what is necessary and vital to them, as well as expressing the information using their own words. Semi-structured questionnaires were used in this study with the learners' parents. The questionnaires also contained open-ended questions (Creswell, 2012; Bibby, 2002). As such, I have coded the responses from the

questionnaires according to the analytical framework and the same figures and tables used for the learners and teachers were used for the parents as a cluster.

As previously mentioned, the parents of the ten learners are participants in this study. In line with this, the ten parents are Parent 1 - P(Busisiwe), Parent 2 - P(Thapelo), Parent 3 - P(Sipho), Parent 4 - P(Lebogang), Parent 5 - P(Mpho), Parent 6 - P(Lisa), Parent 7 - P(Karl), Parent 8 - P(Lerato), Parent 9 - P(Cindy) and Parent 10 - P(Charles). I examine a cluster of the parents in detail, by exploring the influences of their inferred perceptions of mindsets toward the learning of a, SFSCS like mathematics. A case study of the ten parents is given below. It is noteworthy here that, in a situation whereby the number of the parents who responded concerning a category is greater than or equal to nine, five parents with similar excerpts are exemplified. More so, in a situation whereby the number of the parents who responded concerning a category is less than nine, four parents with similar excerpts are exemplified. Additionally, in a situation whereby the number of the parents who responded concerning a category is less than or equal to four, the parents with similar excerpts are exemplified. As such, I present findings for the ten parents, according to Illeris's three dimensions of learning and Dweck's two types of mindsets, as well as discuss the influence of their perceptions of mindset regarding mathematics learning.

7.3.1 A collective cases of ten parents

P(Busisiwe), P(Thapelo), P(Sipho), P(Lebogang), P(Mpho), P(Lisa), P(Karl), P(Lerato), P(Cindy) and P(Charles) are the parents of Busisiwe, Thapelo, Sipho, Lebogang, Mpho, Lisa, Karl, Lerato, Cindy and Charles respectively. Figure 24 and Table 30 present summaries of the findings of the questionnaire administered to parents.

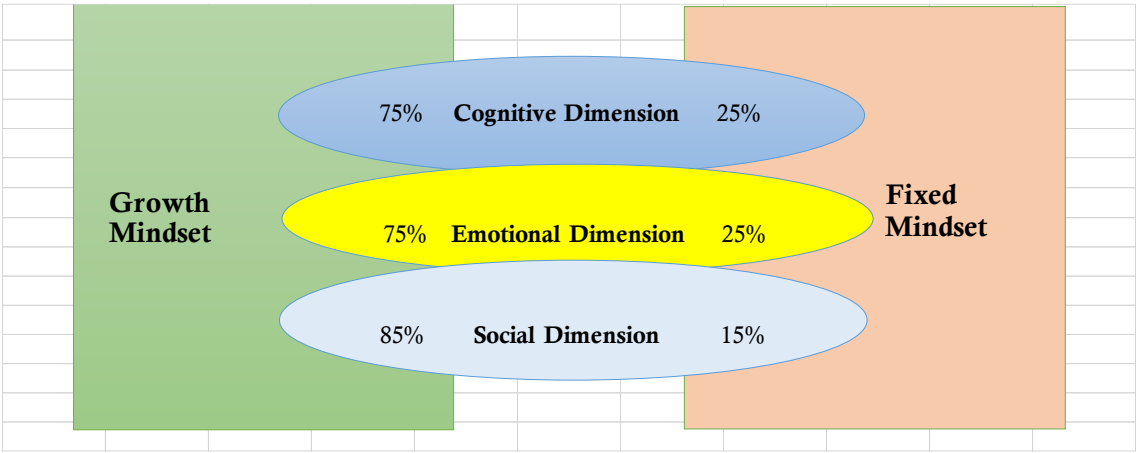


Figure 24: Representation of summary of parents' profile of mindsets within Illeris's dimensions of learning

Figure 24 shows parents' frequencies of responses, with 75% of the responses within the cognitive growth mindset; 25% within the cognitive fixed mindset, at the cognitive level; 78% within the emotional growth mindset; 22% within the emotional fixed mindset, at the emotional level; 85% within the social growth mindset; and 15% within the social fixed mindset, at the social level.

Below is a table presenting further details of parents' cases itemising the categories with their corresponding frequencies within their dimensions respectively, as well as the percentages of each dimension concerning the growth mindset and fixed mindset.

Table 30: Summary of ten parents categorisation of mindsets within Illeris's dimensions of learning

Dimension of Learning	Growth Mindset		Fixed Mindset	
Cognitive dimension	Learning not innate Errors as a resource in learning Learning mathematics as valuable	15/20 (75% of all categories in the cognitive dimension are growth mindset)	Born smart in learning Errors as a setback in learning Learning mathematics is abstract	5/20 (25% of all categories in the cognitive dimension are fixed mindset)
Emotional dimension	Excited when learning Learning through practice and perseverance Learning with confidence Feeling competent to learn	30/40 (75% of all categories in the emotional dimension are growth mindset)	Bored when learning Laissez-faire attitude towards learning Learning with uncertainty Learning with inadequateness	10/40 (25% of all categories in the emotional dimension are fixed mindset)
Social dimension	Learners' attribute inconsequentiality in learning Learning through participation Learning through support	17/20 (85% of all categories in the social dimension are growth mindset)	Learners' attribute influences learning Non-participation in class	3/20 (15% of all categories in the social dimension fixed mindset)

On the cognitive level, Table 30 indicated that the parents' responses were predominantly cognitive growth mindset constituting 75% of all incidents with the most frequent (9 incidents) responses of views that mathematics learning is valuable – useful and important. More so, the parents have a belief that mathematics intelligent people are not born with it, but acquire it through learning, hard work and perseverance (6 incidents). However, there is (are) no direct question(s) regarding mistakes as a resource in learning, hence, there is no specific

response in this category. On the other hand, the parents noted, in 4 incidents, a belief that mathematics intelligent people are born with the ability, rather than acquiring it through learning, hard work and perseverance. They also mentioned, in 1 incident, the views that learning mathematics is not useful. These two categories are within the cognitive fixed mindset. However, there is no direct question(s) regarding errors as a setback in learning, hence, there is no specific response in this category as well.

Within the emotional dimension, the parents were predominantly emotional growth mindset (75%), with perceptions in 8 incidents of their views that mathematics learning requires practice and perseverance. Equally, the parents in 8 incidents perceive that their children feel excited when learning mathematics. They (children) are confident in learning mathematics (7 incidents), as well as competent, (7 incidents). Conversely, the parents acknowledged, in 2 incidents, that their children feel bored when learning mathematics and perceived that they (children) have a laissez-faire attitude towards mathematics learning (2 incidents) and learn the subject with uncertainty (3 incidents) and inadequacy (3 incidents). These four categories are within the emotional fixed mindset.

In the social dimension, the parents' responses were predominantly social growth mindset (85%), noting that learning mathematics requires support (10 incidents), learners' attributes are inconsequential in learning mathematics (7 incidents) and participation is critical in learning mathematics (2 incidents). However, there is no direct question(s) concerning learning through participation, hence, there is no specific response in this category. On the other hand, the parents noted, in 3 incidents, that learners' attributes influence learning. This category is within the social fixed mindset. However, there is (are) no direct question(s) concerning non-participation in class, hence, there is no specific response in this category as well.

Generally, the parents' responses from the administered questionnaires were predominantly growth mindset within all dimensions, i.e., cognitive, emotional and social dimensions. In the next sub-section, I provide a qualitative analysis of the extracts with specific responses within the three dimensions of learning.

7.3.1.1 Parents' cognitive mindsets

As indicated in Table 30 regarding the cognitive mindsets, six parents have a strong belief that learners are not born smart in learning mathematics mathematics learning is not innate (inborn). This is grouped within the cognitive growth mindset. The assertions below exemplified this finding for four parents:

> No, Charles does not need to be 'special' to be good in mathematics because he is capable of doing it on his own. He has the belief that there is enough space for him to do very much better in mathematics learning because no learner is talented in mathematics learning [P(Charles)].

Another parent asserted that their son, Thapelo, does not need to be 'special' at SFSCS learning, but needs to study hard to be good at it:

> He does not need to be "special" to be good in mathematics because anyone can do it if he/she puts more effort into it [P(Thapelo)].

A parent concurred that their daughter does not need to be 'special' at SFSCS and its learning, as everyone has the possibility and potential to learn it effectively:

> No, Lisa does not need to be 'special' to be good at mathematics because every child can do mathematics; in other words, she is 'special' in her own way - with putting more effort into mathematics learning, she will achieve more or do better with time. [P(Lisa)].

P(Cindy) agreed that Cindy does not need to be 'special' to be good at SFSCS and its learning as well, but through practising it:

> No, she does not need to be 'special' to be good at mathematics because I believe that mathematics is a study subject. Mathematics involves a skill that can be learned and then practiced to perfection [P(Cindy)].

P(Charles)'s, P(Thapelo)'s, P(Lisa)'s and P(Cindy)'s assertions above reveal that their children are not talented or born to learn mathematics effectively. These beliefs are related to a growth mindset and they afford learning of the subject. The growth mindset positively influences learners' thinking, which in turn influences their learning positively. Literature suggests that this positive belief affords success in learning, as the learners believe that intelligence and smartness are not inborn but can be learned (Bernecker et al, 2019; Haimovitz & Dweck, 2017; Dweck, 2006a & 2006b).

On the other hand, as indicated in Table 30 concerning the cognitive mindsets, four parents have a strong belief that learners are born smart in learning mathematics - that is mathematics learning is innate (inborn). This is grouped within the cognitive fixed mindset. The assertions below exemplified this finding for the four parents:

> Yes, my son needs to be 'special' to be good at mathematics because he is gifted already. Karl needs to be 'special' to be good in mathematics, that is why he is saying that he is exceptional in mathematics. To me, it means he is gifted. I do not think anyone can do mathematics very well [P(Karl)].

P(Lerato) asserted that their daughter needs to be 'special' to be good at learning SFSCS, as such some people are exceptional in learning it:

> Yes, my child needs to be 'special' to be good at mathematics because special people perform exceptionally well in mathematics learning [P(Lerato)].

His parent agreed that Karl needs to be 'special' to be good at learning SFSCS, as he is talented at learning it:

> Yes, my son does not need to be 'special' to be good at mathematics, because he is saying that he is exceptional in mathematics. He tells me that he is gifted and smart because he finds the solution to a mathematical problem easygoing most times. My son's belief towards

> mathematics learning is that he is exceptional - gifted in mathematics learning. To me, it means he is gifted. I do not think everyone can do mathematics very well [P(Karl)].

P(Busisiwe) concurred that their daughter needs to be 'special' to be good at learning SFSCS, as everyone cannot learn it effectively:

> Yes, my daughter needs to be 'special' to be good at mathematics. She also says mathematics is for special learners. More so, she beliefs that mathematics is not for all. [P(Busisiwe)].

P(Lebogang) added that Lebogang needs to be 'special' to be good at learning SFSCS, as some people are outstanding in learning it:

> Yes, my child needs to be 'special' to be good at mathematics because special people perform exceptionally well in mathematics learning [P(Lebogang)].

P(Lerato)'s, P(Karl)'s, P(Busisiwe)'s and P(Lebogang)'s assertions above reveal that some learners are born with the intelligence of mathematics to effectively learn it. These beliefs are a fixed mindset and they constrain mathematics learning. Literature suggests that this negative belief constrains success in learning the subjects, as people believe that intelligence and smartness are innate and cannot be learned, that is nothing anyone can do to change these central personalities. This is evident in how the learners engage with their learning. Mindsets have a vital role in learning, as they affect learning (Bernecker et al, 2019; Haimovitz & Dweck, 2017; Zhang, Kuusisto & Tirri, 2017; Boaler, 2013; Dweck, 2013b; Dweck, 2006a & 2006b).

As indicated in Table 30 regarding the cognitive mindsets, nine parents have positive views about the usefulness and importance of learning mathematics. This is grouped within the cognitive growth mindset. The assertions below exemplified this finding for five parents:

> Yes, my daughter says mathematics is useful because she applies it in her daily living and sciences. I will love my daughter to be engaged with mathematics in the future because mathematics will open doors for the career she wants to take [P(Busisiwe)].

P(Sipho) asserted that their son, Sipho, said that learning an SFSCS, like mathematics, is valuable, as it enhances the knowledge of other related subjects:

> Yes, my son says mathematics is useful to him and it helps him to effectively understand other subjects. Mathematics will be useful to my son's future career. I will love my son to be engaged with mathematics in the future because it is so important. I think mathematics is a subject, we all need most in our everyday life [P(Sipho)].

In the same vein, P(Mpho) asserted that Mpho said that learning an SFSCS is vital, as it enhances her career choice:

> Yes, my child says mathematics is useful. She usually says mathematics is useful since mathematics will help her to perform well in the subjects that use it. I will love her to be engaged with mathematics in the future because she wishes to be a medical doctor and mathematics will be fundamental in her studies; she is very much aware of it [P(Mpho)].

A parent agreed that their daughter said that learning a, SFSCS, like mathematics, is indispensable, since it is a tool that is needed in her career choice, as well as by everyone:

> Yes, she says mathematics is useful always because it will help her future career and give her a good head start. Mathematics will be useful to her future career. I will love her to be engaged with mathematics in the future because mathematics is a good tool and needed in one's everyday lifestyle [P(Lisa)].

P(Cindy) added that Cindy said that SFSCS learning is essential because she enjoys it and it is applied in science subjects:

> Yes, she says mathematics is useful - as it improves her analytical ability and t is a tool in sciences. Mathematics will be useful to her future career. I want her to be engaged with mathematics in the future because it is something, she likes P[(Cindy)].

P(Busisiwe)'s, P(Sipho)'s, P(Mpho)'s, P(Lisa)'s and P(Cindy)'s assertions above reveal that their children perceive mathematics and its learning as crucial and valuable, as well as applicable to related subjects and life endeavors and future careers. These are associated with a growth mindset and they afford learning of the subject. Literature suggests that mathematics and its learning afford the learning of other related subjects (Obomanu & Adaramola, 2011; Maliki, Ngban & Ibu, 2009; Reyes & Stanic, 1998).

On the other hand, as indicated in Table 30, regarding the cognitive mindsets, one parent has negative views about the usefulness and importance of learning mathematics. This is grouped within the cognitive growth mindset. The assertions below exemplified this finding for the one parent:

> Yes, Thapelo says mathematics is not useful. That is a waste of time. He is just taking it since it is compulsory. This could be true. He says mathematics is mainly boring. That is waste of time and equally not useful to him in anyways. He shows these attitudes.

The above assertion by P(Thapelo) reveals that he perceives mathematics learning as not useful and a waste of time. This is an indication of a fixed mindset and the perception constrains learning of the subject, which negatively influences learning as well (Destin et al., 2019; Zhang, Kuusisto & Tirri, 2017; Uwerhiavwe, 2014).

7.3.1.2 Parents' emotional mindsets

As indicated in Table 30, concerning the emotional mindsets, eight parents responded that their children feel excited when learning mathematics. This is classified within the emotional growth mindset. The extracts below illustrate this finding for four parents:

> Yes, my son is interested and so excited about doing mathematics. He said mathematics is fun. Some of my son's attitudes towards mathematics: he always happy when it comes to mathematics. My son enjoys mathematics [P(Sipho)].

P(Lisa) concurred that learning an SFSCS, like mathematics, is fun for Lisa, as she enjoys learning it:

> Yes, Lisa says mathematics is fun because there is joy in doing mathematics and numbers are fun as well. She enjoys mathematics. She says mathematics is interesting because no matter how difficult a problem is, there is always a way out to solving it to arrive at the answer. Also, she says mathematics is like life, there is always a problem to solve [P(Lisa)].

In the same manner, P(Karl) noted that their son enjoys SFSCS and its learning, as well as being interested and excited to earn SFSCS:

> Yes, my son says mathematics is interesting because it makes them compete against each other in the classroom during tasks and it is always an exciting moment. Karl says mathematics is fun. He enjoys solving mathematics problems. He is interested in doing mathematics [P(Karl)].

In addition, P(Cindy) said that their daughter is interested, excited and enjoys studying an SFSCS:

> Yes, she says mathematics is difficult. However, she is excited to solve difficult mathematics questions. She does say mathematics is fun and she enjoys mathematics. She says that she loves mathematics and has a keen interest in it. She is always happy to learn mathematics [P(Cindy)].

In light of the above extracts by P(Sipho), P(Karl), P(Lisa) and P(Cindy), there are indications that their children find mathematics and its learning interesting, exciting and enjoyable. These perceived attitudes of the learners are a pointer to a growth mindset and they enhance learning of the subject. Literature suggests that learners who have constructed a growth mindset in learning mathematics revealed a substantial increase in their interest, valuing and enjoyment of the subject (Uwerhiavwe, 2014; Boaler, 2013).

On the contrary, as indicated in Table 30 concerning the emotional mindsets, two parents responded that their children felt bored when learning mathematics. This is classified within the emotional fixed mindset. The extracts below illustrated this finding for the two parents:

> Yes, he says mathematics is mainly boring. He says mathematics is not interesting sometimes because it is difficult most times and he does not find it interesting and fun when it is difficult [P(Thapelo)].

P(Charles) concurred that Charles acknowledged that SFSCS and its learning is boring and not enjoyable:

> Yes, he says mathematics is boring when sitting for two periods at a go. He says mathematics is not interesting sometimes because it is difficult most times and he does not find it interesting and fun when it is difficult [P(Charles)].

In light of the above extracts, P(Thapelo) and P(Charles) indicated that Thapelo and Charles find mathematics and its learning boring. This negative attitude is associated with a learner

who holds a fixed mindset and it has consequences for learning mathematics, as it constrains effective learning of the subject. If a learner has a negative attitude towards mathematics and its learning, this will reflect on his/her performance in the subject and other related subjects, negatively (Uwerhiavwe, 2014; Darragh, 2013; Maliki, Ngban & Ibu, 2009).

As indicated in Table 30 concerning the emotional mindsets, eight parents responded on learning mathematics through practice and perseverance. This is classified within the emotional growth mindset. The extracts below illustrated this finding for four parents:

> Yes, she is all the time willing and determined in reading and practicing mathematics. she is committed and full of zeal for mathematics learning. My daughter is committed to mathematics because she wants to know more. Whenever she gets home from school, she practices mathematics. With her zeal in mathematics, she will achieve more because she puts in a huge effort and keeps on studying it to know more [P(Busisiwe)].

In agreeing with this, a parent confirmed that their daughter is determined and committed to reading and practising a, SFSCS, as well as put effort into studying it:

> Yes, Lebogang is willing and determined in reading and practicing mathematics. She is committed. My child reads and practices mathematics at home. My child beliefs that she can do better in mathematics learning by putting more and more effort into it. Hence, she continues to solve it even in difficult situations; which shows that she is interested and determined [P(Lebogang)].

In the same vein, P(Mpho) responded that Mpho reads and practises an SFSCS, as well as willing and motivated to learn it:

> Yes, she is motivated and determined in reading and practicing mathematics. She is committed to mathematics to the extent that she practices mathematics in between her studies at home [P(Mpho)].

P(Charles) added that Charles is willing and motivated to learn an SFSCS as well. More so, he persists when learning it:

> Yes, he is determined in reading and practicing mathematics. He reads and practices mathematics at home. He is committed to mathematics and never gives up even on very difficult problems [P(Charles)].

The above extracts by P(Busisiwe), P(Lebogang), P(Mpho) and P(Charles) indicate that their children persist and put extra effort to read and practise mathematics in the face of difficulties. That is, they persist in solving mathematics problems until they understand them and have good knowledge of them. These are associated with a growth mindset and it affords success in the learning of the subject. It is evident that learners who hold a growth mindset can grow their intelligence and abilities stronger over time by doing hard tasks and persisting. The learners perceive efforts as necessary for mathematics learning (Appell, 2019; Haimovitz & Dweck, 2017; Popova, 2014).

On the contrary, as indicated in Table 30 concerning the emotional mindsets, two parents responded on their children's laissez-faire attitudes towards mathematics learning. This is classified within the emotional growth mindset. The extracts below illustrated this finding for the two parents:

> No, Thapelo is not willing and determined in reading and practicing mathematics. He says mathematics is mainly tiring. Anyways, I observe this when he is reading it at home because he shows this attitude. He is not committed to mathematics because he does not put time to study it. I am not impressed with his achievement in mathematics because he is not even interested or determined to put more effort when in difficulties [P(Thapelo)].

P(Karl) agreed that Karl does not study a, SFSCS, as he is not dedicated to it:

> No, my child does not read and practices mathematics at home; we barely witness him read and practice mathematics on his own. This means he is not all that committed to mathematics. [P(Karl)].

The above extracts by P(Thapelo) and P(Karl) indicate Thapelo's and Karl's dispositions of lack of commitment, determination and perseverance in learning mathematics. Simply put, Thapelo and Karl are lazy, as they do not put in extra effort and persist when combated with challenges in learning mathematics. These dispositions are indications of a fixed mindset and they constrain learning, as well as lead to failure in the subject. Literature suggests that, when

learners with a fixed mindset are faced with challenges in learning mathematics, they quit on it. Such learners frequently avoid challenges, instead, they prefer to do easier tasks in which they want to succeed (Haimovitz & Dweck, 2017; Boaler, 2013).

As indicated in Table 30 concerning the emotional mindsets, seven parents responded t their children's attitudes regarding their confidence in learning mathematics. This is classified within the emotional growth mindset. The extracts below illustrated this finding for four parents:

> Yes, my son is so confident in mathematics [P(Sipho)].

A parent agreed that their daughter has self-confidence in SFSCS and its learning:

> Yes, my child shows signs of confidence in mathematics [P(Lebogang)].

In the same vein, P(Mpho) affirmed that their daughter also has self-confidence in learning SFSCS:

> Yes, she shows signs of being confident in mathematics [P(Mpho)].

In addition, P(Lerato) noted that Lerato is confident in doing SFSCS:

> Yes, my child shows signs of great confidence in mathematics [P(Lerato)].

There are indications from P(Sipho)'s, P(Lebogang)'s, P(Mpho) and P(Lerato)'s extracts that their children are self-confident in mathematics and its learning. This is related to learners who have developed a growth mindset, as it affords learning mathematics. Literature suggests that a learner who is confident in learning holds a growth mindset, using Bishop's illustration. This enables the learner to do what he/she wants successfully and it affords an understanding

of the subject. As such, a learner needs to demonstrate self-confidence to be successful in learning (Darragh, 2013; Graven, 2013; Bishop, 2012).

On the contrary, as indicated in Table 30 concerning the emotional mindsets, three parents responded about their children's attitudes regarding their learning mathematics with uncertainty. This is classified within the emotional fixed mindset. The extracts below illustrated this finding for the three parents:

> No, Thapelo does not show any signs of being confident in mathematics [P(Thapelo)].

P(Lisa) concurred that Lisa lacks self-confidence in SFSCS and its learning:

> No, she does not show signs of confidence most times in mathematics [P(Lisa)].

P(Charles) added that Charles, likewise, lacks self-confidence in learning SFSCS:

> He does not show enough signs of being confident in mathematics [P(Charles)].

There are indications from P(Thapelo)'s, P(Lisa)'s and P(Charles)'s extracts that their children lack self-confidence in mathematics and its learning – that is they (Thapelo, Lisa and Charles) learn mathematics with uncertainty. This is related to learners who have developed a fixed mindset, as it constrains learning the subject. Literature suggests that a learner who is confident in learning holds a growth mindset, using Bishop's illustration. This implies that a learner who is not confident (lacks self-confidence) holds a fixed mindset. This does not enable the learner to do what he/she wants to do successfully and it constrains an understanding of the subject (Darragh, 2013; Graven, 2013; Bishop, 2012).

As indicated in Table 30, concerning the emotional mindsets, seven parents responded about their children's attitudes regarding their competence in learning mathematics. This is

classified within the emotional growth mindset. The extracts below illustrated this finding for four parents:

> Yes, my daughter is competent in mathematics [P(Busisiwe)].

P(Karl) agreed that Karl has the capability to learn an SFSCS:

> Yes, he is competent in mathematics [P(Karl)].

In the same vein, a parent confirmed that their daughter is capable of learning an SFSCS:

> Yes, she is so competent in mathematics [P(Lerato)].

Another parent concurred that their daughter has competence in SFSCS and its learning:

> Yes, she is very competent in mathematics [P(Cindy)].

The above extracts by P(Busisiwe), P(Karl), P(Lerato) and P(Cindy) indicate that their children are competent in learning mathematics. That is, Busisiwe, Karl, Lerato and Cindy have the competence to do mathematics effectively. This is an indication of learners who hold a growth mindset and it affords effective learning of the subject. Literature suggests that every learner must be competent to study mathematics; a learner who is competent in learning mathematics will be able to learn it (mathematics) effectively, as numerical competencies have a positive influence on learning the subject (Bansilal, Webb & James, 2015; Darragh, 2013; Bishop, 2012).

On the contrary, as indicated in Table 30 concerning the emotional mindsets, three parents responded about their children's attitudes regarding their learning mathematics with inadequateness. This is classified within the emotional growth mindset. The extracts below illustrated these findings for the three parents:

> No, Thapelo is not competent in mathematics [P(Thapelo)].

P(Lisa) corresponded that Lisa lacks self-competence in SFSCS and its learning:

> No, she is not competent in mathematics [P(Lisa)].

P(Charles) added that Charles, likewise, lacks self-confidence in learning SFSCS:

> No, he is not competent enough in mathematics [P(Charles)].

The above extracts by P(Thapelo), P(Lisa) and P(Charles) indicate that their children are not competent in learning mathematics. That is, Thapelo, Lisa and Charles lack self-competence to do mathematics effectively. This is an indication of learners who hold a fixed mindset and it constrains effective learning of the subject. Literature suggests that every learner must be competent to study mathematics. Invariably, a learner who is not competent in learning mathematics will not be able to learn it (mathematics) effectively, as a lack of numerical competencies has a negative influence on learning the subject (Bansilal, Webb & James, 2015; Darragh, 2013).

7.3.1.3 Parents' social mindset

As indicated in Table 30 relating to the social mindsets, seven parents perceive that learners' attributes are inconsequential in mathematics learning. This is grouped within the social growth mindset. The extracts below demonstrate this finding for four parents:

> Mathematics learning and race are two different things apart. Charles does not perceive race as having anything to do with one's mathematics learning. Equally, he does not perceive one's gender as having anything to do with his/her learning. That is a learner's gender has nothing to do with his/her mathematics learning [P(Charles)].

P(Sipho) affirmed that learners' attributes, such as race and gender, are inconsequential in SFSCS and its learning:

> Race and mathematics are two different things. They do not affect each other. You study mathematics to know it. My son put a lot of effort to have good knowledge of it. He always says that anyone can be good at mathematics if he chooses to. Race is just one's complexion. Therefore, any of the genders can be good at it [P(Sipho)].

In the same manner, P(Lerato) responded that race and gender are not connected to SFSCS and its learning:

> Race and mathematics learning are two different things. Mathematics is calculations, while race is about someone's category in terms of colour. To be able to calculate very well involves effort. Race, you have no control over it. Lerato believes that everyone can learn mathematics very well irrespective of one's race everyone can learn mathematics very well. Furthermore, gender has no impact on mathematics learning. Lerato believes that mathematics is for every learner irrespective of gender [P(Lerato)].

Agreeing with the above, another parent's perception is that learners' attributes, such as race and gender, do not relate to SFSCS learning:

> Cindy says mathematics learning does not have anything to do with a learner's race. Everyone can do mathematics successfully regardless of his/her race. I believe Cindy's views are right since mathematics can be successfully learned by anyone. More so, Cindy says mathematics is for all genders. Every gender has the potentials to do mathematics successfully. I think Cindy's views are right because mathematics is specifically for no one [P(Cindy)].

P(Charles)'s, P(Sipho)'s, P(Lerato)'s and P(Cindy)'s extracts above show that learners' attributes, learners' level of capability in mathematics and its learning, is not linked to race and gender. That is having good knowledge of mathematics, for him, is not a function of one's attributes: race and gender. These are indications of a growth mindset toward learning and they afford effective learning of the subject. Racial and gender differences in mathematics and its learning only exist among learners who hold a fixed mindset. Invariably, gender differences in learning do not exist among learners who hold a growth mindset (Haimovitz & Dweck, 2017; Boaler, 2013; Martin, 2006; Nasir & Hand, 2006; Skovsmose, 2005; Reyes & Stanic, 1998).

Conversely, as indicated in Table 30 relating to the social mindsets, three parents perceived that learners' attribute influences learning. This is grouped within the social growth mindset. The extracts below demonstrate this finding for the three parents:

> Race affects mathematics learning. That is why you see that Whites are smarter than Blacks in mathematics. Gender also affects mathematics learning. Males are smarter always when compared to females. If Mpho was a male, she would have been very much smarter than what she is [P(Mpho)].

In the same vein, P(Lisa) responded that race and gender are connected to SFSCS and its learning:

> Whites are more knowledgeable in mathematics than others. Some Whites are not too knowledgeable in mathematics like Lisa but cannot be like others. Again, males are better at mathematics learning. Lisa would have been better but she is a female. That extra energy is not there [P(Lisa)].

P(Karl) concurred that learners' attributes, such as race and gender are inconsequential in SFSCS and its learning:

> Mathematics learning has a lot to do with race. My son demonstrates this. He tells me that he is smart at mathematics without much reading and practicing it and understands it without effort. Also, gender is very important in mathematics learning too. Karl tells me that often and it shows in its mathematics examinations [P(Karl)].

P(Mpho)'s, P(Lisa)'s and P(Karl)'s abstracts above show that learners' attributes, their level of capability in mathematics and its learning, are linked to race and gender. That is having good knowledge of mathematics, for him is a function of one's attributes: race and gender. These are indications of a fixed mindset toward learning and they constrain effective learning of the subject. Literature suggests that racial and gender differences in mathematics and its learning only exist among learners who hold a fixed mindset (Haimovitz & Dweck, 2017; Boaler, 2013; Martin, 2006; Nasir & Hand, 2006; Skovsmose, 2005; Reyes & Stanic, 1998).

As indicated in Table 30 relating to the social mindsets, all the parents responded on the amount of support that their children get whenever they (children) need, or seek, support

from their family members. This is grouped within the social growth mindset. The abstracts below demonstrate this finding for five parents:

> Yes, I contribute to my child's mathematics learning by helping her with the mathematics problems and going through her books with her. I assist her at home in doing her mathematics homework. I am able to support and provide Busisiwe with her needs to effectively learn mathematics because when she needs anything that is school-related, I do not hesitate to provide [P(Busisiwe)].

P(Thapelo) asserted that Thapelo is given the necessary support needed for effective learning of an SFSCS:

> Yes, my family members contribute to his mathematics learning due to the fact that sometimes when he does not understand, the sister helps him. We do support and provide him with all his needs to effectively learn mathematics. We are teaching him at home. His family members assist him in doing his mathematics homework. We purchase all his needs to learn mathematics [P(Thapelo)].

In the same vein, P(Lisa) asserted that Lisa is provided with support that she needs to do an SFSCS effectively:

> Yes, we contribute to her mathematics learning because as a sister, I always find time to help Lisa as possible with mathematics due to the fact that I know it is a big challenge and she quickly gets frustrated with it and gives up at times. We assist Lisa in doing her mathematics homework [P(Lisa)].

A parent agreed that their daughter is provided with her needs to enable effective learning an SFSCS, like mathematics:

> Yes, we contribute to her mathematics learning. I am always available to assist my daughter in all ways. I am able to support and provide my daughter with all her needs to effectively learn mathematics [P(Mpho)].

P(Karl) added that Karl gets support for effective learning a SFSCS:

> Yes, we contribute to my child's mathematics learning. We assist him in doing his mathematics homework. His sisters explain and help where they can [P(Karl)].

P(Busisiwe)'s, P(Thapelo)'s, P(Lisa)'s, P(Mpho)'s and P(Karl)'s extracts show that Busisiwe, Thapelo, Lisa, Mpho and Karl get the amount of support they need in mathematics

and its learning at home from their parents (family members). This is associated with a growth mindset, since it affords learning of the subject. When learners receive the necessary support for effective learning from people, it affords the learners in the learning process (Martin, 2006; Nasir & Hand, 2006; Reyes & Stanic, 1998).

7.4 Summary of findings across the parents

There are ten learners' parents presented in Chapter 4: P(Busisiwe), P(Thapelo), P(Sipho), P(Lebogang), P(Mpho), P(Lisa), P(Karl), P(Lerato), P(Cindy) and P(Charles). The parents' responses were examined in detail by exploring the influences of their views of the mindsets of their children on the learning of an SFSCS like mathematics.

Although some of the parents in this study did not subscribe to innatist views, most of the parents held innatist assumptions, about performance, race, gender and ability. Based on ability, some of the parents assumed that people's ability to do, and towards, mathematics, as well as attitudes and beliefs about mathematics and its learning is what the learners are born with [that they did not learn]. In order words, not being able to do mathematics was something innately given to them. That is, they see words, ability, beliefs and attitudes occuring naturally: they are not man-made, but from God or nature (Lee, 2005; Mill, 1998). This informs the mindsets, which in turn, influences mathematics and its learning.

There are, however, ongoing assumptions about racism and sexism which inform the mindsets. The data indicates that, whether the learner is Black or White, male or female, when the mathematics experiences are actually constructed in a positive way, a growth mindset is developed. They are likely to relate to the subject better and perform better (Sparks, 2015; Mata, Monteiro & Peixoto, 2012). In this sense, racism and sexism influence people. In turn, this influences learning.

Support is available from the parents, probably it is not always used. Support also seems to come in when learners do not perform the way they should in general. In this light, support influences learners' achievements in mathematics learning. If a learner does not get support, he/she does not achieve. Anderson (2007) and Pipere and MiEule (2014) have indicated the importance of support, and the data of this study confirm that. What is important is that, if learners are given positive experiences in mathematics learning and if the environment is constructed in a way which supports them, it will enable the learners to develop their confidence and ability, whether they are White or Black learners, male or female. These learners will then be able to understand mathematics well and perform positively in mathematics and its learning. In this light, I agree with Martin (2012) that all learners [whether Blacks, Whites, or others] have the ability to learn mathematics.

Social support of the social dimension is very critical for positive achievement or good performance in the learning process. In Table 30, social support is more in terms of the number of responses from the parents in all the categories. That is, the parents' responses were completely (all) social growth mindset at the social level, in fact, at all levels. Furthermore, at the cognitive and emotional levels, parents' perceptions about the learners were more cognitive growth mindset and emotional growth mindset.

Ensuing from the above, the social dimension seems essential to all the dimensions. That is, the social dimension seems very critical when compared to the cognitive and emotional dimensions. More so, the parents' perceptions concerning the learners are not completely (100%) growth mindset or fixed mindset.

7.5 Synthesis of findings across the teachers and parents

As previously mentioned, there were three teachers in this study: Mr Vuyo, Mrs Thando and Mr Kabelo. More so, there were ten parents: P(Busisiwe), P(Thapelo), P(Sipho), P(Lebogang), P(Mpho), P(Lisa), P(Karl), P(Lerato), P(Cindy) and P(Charles). I have examined each of the teachers and clusters of the parents in detail, by exploring the influence of their views of the mindsets of their learners and/or children on the learning of a SFSCS like mathematics. As such, Figure 23 presents a comparison of the findings of the interview with the three teachers and responses by the ten parents in the administered questionnaires. In order to present the chart [in Figure 23] below, I allocated the value 1 to teachers' and parents' perceptions about the learners' fixed mindset; the value 1.5 to the situation, whereby a teacher's or parent's perceptions about the learners' fixed mindset are similar to the teacher's or parent's perceptions about the learners' growth mindset, i.e. where a learner's teacher's or parent's perceptions about their fixed and growth mindsets have the same number of responses; and the value 2 to teachers' and parents' perceptions about the learners' growth mindset. That is, when a response is about fixed mindset, it is 1; when a response about fixed mindset is similar to a growth mindset, it is 1.5 and, when a response is about growth mindset, it is 2.

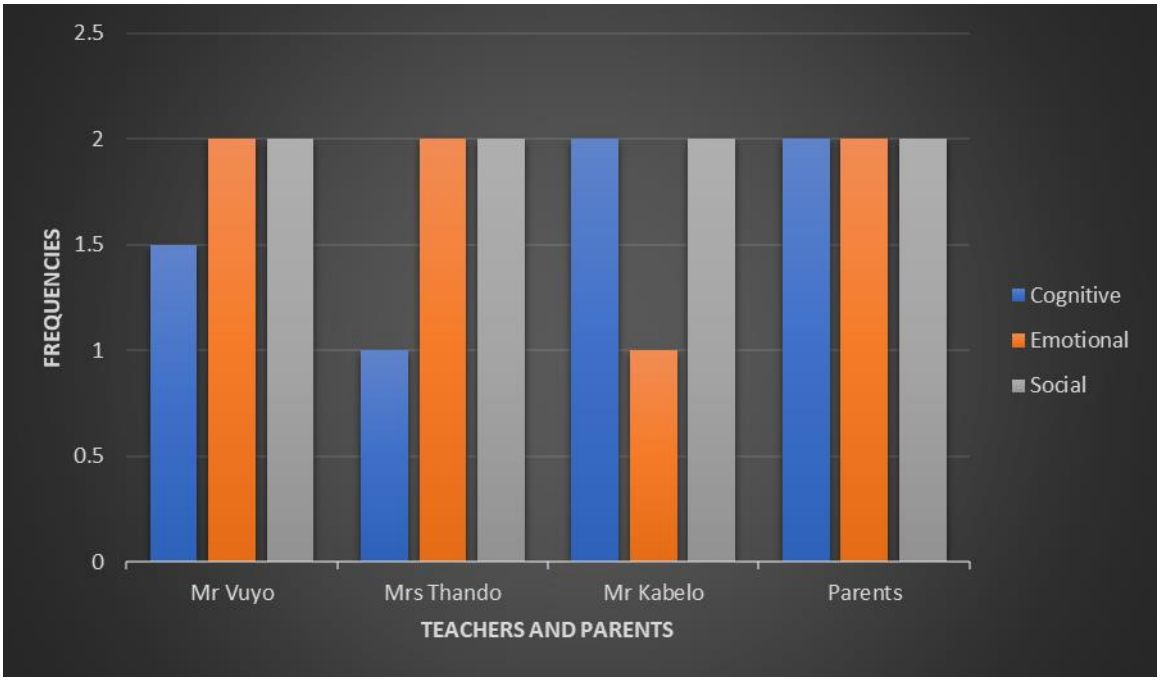


Figure 25: Summary of the three teachers' and ten parents' profile of mindsets within Illeris's dimensions of learning

In light of the analysis of findings based on the perceptions of three learners' mathematics teachers and learners' parents of their learners/children, the chart indicates that none of the teachers and the parents are the same - the columns of the teachers and parents vary. Put simply, the three teachers' perceptions about their learners are different from each other, which are also different from the parents'. Mr Vuyo is growth and fixed within the cognitive dimension, i.e. his perceptions reflecting the growth mindset and fixed mindset about his learners at the cognitive level have equal frequency. Mrs Thando is fixed within the cognitive dimension. Mr Kabelo and the parents are growth within the cognitive dimension. Furthermore, Mr Vuyo, Mrs Thando and the parents are growth within the emotional dimension. Mr Kabelo, however, is fixed within the emotional dimension. Notably, all the teachers and parents are growth within the social dimension. It is worth noting that the parents' case is typical, as their perceptions are growth in terms of the cognitive, emotional and social dimension, that is, they are not deficit cognitively, emotionally and socially.

Overall, ensuing from the analysis of findings, given the teachers' and parents' perceptions concerning the learners'/children's mindsets, there is an influence of mindset on their achievement, which is located in the cognitive, emotional and social, which, in turn, influence their achievements in the learning process.

7.6 Summary

In this chapter, I found from the teachers and parents that learners' mindsets, beliefs, attitudes and perceptions are not something innate, but are socially constructed. More so, ability in mathematics and its learning is not what the learners are born with, but acquired through learning the subject. Support is available from the parents and it influences learners' achievements in mathematics learning.

Furthermore, I likewise found that, teachers' and parents' perceptions regarding their learners' and/or their children's mindsets, have various consequences for learning, such as the growth mindset, which points to a positive influence on learning, as it affords learning and leads to success in learning and the fixed mindset, which seems to points to a negative influence on learning, as it constrains learning and fundamentally leads to failure (Tirri & Kujala, 2016; Dweck, 2006a; Dweck, 2006b).

The cognitive, emotional and social dimensions seem to be responsible for influencing the learners' learning leading to achievements or performances in an SFSCS. The teachers' and parents' perceptions about their learners'/children's mindsets show that there is an influence of mindsets on achievement, which is located in the cognitive, emotional and social dimensions in the learning process.

I now proceed to the next chapter: Conclusions.

CHAPTER 8

CONCLUSIONS

8.1 Introduction

Chapter 8 discusses the summary of the entire thesis: **Analysis of the Influence of Mindsets on a Strongly Framed and Classified Subject Using Social Learning Theory**. To bring this research to a close, I begin this chapter with a restatement of the main foci of the research, with emphasis on the analytical process. Subsequently, I move on to provide a summary of the key findings emanating from this study. I then juxtapose the findings that emanated from the analysis of the responses from the interviews and questionnaires, as well as provide the implications of the findings. Thereafter, the contribution of the study to existing knowledge and limitations of the study, as well as recommendations for further studies, are provided.

8.2 The foci of the study

The main foci of the study are to determine how learners' mindsets are developed, which relate to, and influence, their learning of mathematics. Learners' mindsets are mainly developed as a result of the social relations of the learners, since the development of a mindset is also social in nature (Cohen, Manion & Morrison, 2007; Wenger, 1998). Following on the above and given that a case study is descriptive, interpretive, enlightening and gives in-depth understanding with viewpoints, as well as being suitable and fitting for the goals of this study, I used a qualitative case study to characterise the situations in which responses from the participants were given and then analysed the nature of these responses for this study (Creswell, 2012).

The main research question that guided this study is: *What is the influence of learners' mindsets on learning of a strongly framed and strongly classified subject using social learning theory?* I used four sub-questions, based on the three dimensions (cognitive, emotional and social) of social learning theory by Illeris and mindsets theory by Dweck. Data was collected through interviews with ten learners and three teachers; and questionnaires for the ten learners' parents. The key findings emanating from this study are summarised in a section below.

8.3 Summary of the key findings

Four interrelated key findings align with the four research questions that emanated from this study. Below are the following key findings.

1. The role of mindsets in learning within the cognitive dimension of a strongly framed and strongly classified subject.

Drawing on the analysis of all the cases in this study, the cognitive dimension seems to be responsible for influencing the learners' learning leading to their achievements in a strongly framed and strongly classified subject. To a large extent, it was found that growth cognitive mindset is an indicator of high achievement in mathematics. This is to say, having a growth mindset within the cognitive dimension points to a possibility of high achievement in mathematics. This is evident from the findings of the study, where all the five high achieving learners have agrowth mindset within the cognitive dimension of learning. On the other hand, four out of the five low achieving learners have a fixed mindset within the cognitive dimension. To this end, there is a role that mindset plays in the cognitive dimension, which influences the learners' achievement.

2. The role of mindsets in learning within the emotional dimension of a strongly framed and strongly classified subject.

Ensuing from the analysis of all the cases in this study, the emotional dimension also seems to be responsible for influencing the learners' learning leading to their achievements in a strongly framed and strongly classified subject. To a large extent, it was also found that the growth emotional dimension infers high achievement in mathematics. Four out of the five high achieving learners have growth emotional mindsets, while four out of five low achieving learners have fixed emotional mindsets. As such, there is a role that mindset plays in the emotional dimension, such as influencing learners' achievement, which is located in the emotional dimension in the learning process.

3. The role of mindsets in learning within the social dimension of a strongly framed and strongly classified subject.

Based on the analysis of all the cases in this study, the social dimension likewise seems to be responsible for influencing the learners' achievements in a strongly framed and strongly classified subject in the learning process. It was found that positive achievement does not infer that the social dimension must always be positive in the learning process. The social dimension may seem to be constraining learning, however, a learner may still perform well. Also, the social dimension may seem to be affording learning, but a learner may still perform poorly. In this light, there is a role that mindset plays in the social dimension, such as influencing learners' achievement, which is located in the social dimension of the learning process.

The data of this study also indicated that teachers and family members play a crucial role in providing the social support that learners need in order to achieve in a strongly framed and

strongly classified subject (SFSCS). It also showed that these influence learning of the subject. Social support is available from the teachers and parents (family members), but it may not always be used. Social support also seems to feature when learners are not performing the way they should and not in general. Theorists, such as Anderson (2007) and Pipere and MiEule (2014), have indicated the importance of social support and the data of this study confirms this. In light of this, social support influences learners' achievements in learning the subject, mathematics. As such, social support links to good achievement and performers in an SFSCS and its learning. If a learner does not get support in learning mathematics, he/she will not achieve or perform well. This study found that, whether it is an ability, whether it is mindsets, or whether it is beliefs, all of these things emerged out of interactions within the social environment with others, i.e. they are socially constructed.

4. Pattern of mindsets across low and high achieving learners within the three dimensions of learning.

Through the case study analysis process discussed in Chapter 5 and presented in Chapter 6 and Chapter 7, a pattern of mindset based on learner achievements in mathematics can be deduced. Low achieving learners appeared to have fixed mindsets within the cognitive and emotional dimensions of learning. When this is recognised by the learners, they tended to seek help and hence showed a growth mindset within the social dimension of learning. Having a growth mindset within the social dimension does not infer high achievement in mathematics. On the other hand, high achieving learners demonstrate a common pattern of growth across the three dimensions of learning.

The interplay of the cognitive dimension role and the emotional dimension role (which are the internal functions, i.e. the roles of learners' mindsets) is dependent on the process of

interaction between the learners and the social, cultural and material environment (which are the external functions, i.e. the role of other people's mindsets) in the learning process (Illeris, 2009; Illeris, 2003). In light of this, I conclude that learners' mindsets are socially constructed. They (learners) internalised the mindsets, beliefs and attitudes.

This study has indicated that learners' dispositions are unseparated levels. Therefore, the picture is complex. Hence, I am inclined to agree with Dweck (2013c), Carey (2012) and Vermeer's (2012b) notion that mindsets influence learners' attitudes towards SFSCS and its learning. These learners' mindsets (fixed and growth mindsets) are socially constructed. Furthermore, Tshabalala and Ncube (2013) also indicate that high failure rates in SFSCS could be attributed to learners' attitudes, such as the absence of interest, concentration, willingness, determination and anxiety toward mathematics and their grasp of the subject. The high failure rates are a consequence of the learners' mindsets arising from their negative attitudes towards the subject. These learners' attitudes are socially constructed as well.

Maliki, Ngban and Ibu's (2009) also indicated that high achievement in SFSCS is attributed to the learners' positive attitudes toward SFSCS and its learning. In an earlier work (Uwerhiavwe, 2014), I indicated that low achievement in SFSCS is directly related to the learners' negative attitudes toward the subject and its learning in senior secondary school in Delta State, Nigeria. Maliki, Ngban. Ibu's (2009) also noted that low achievement in SFSCS is a consequence of the learners' dispositions resulting from their negative attitudes toward an SFSCS and its learning. These learners' dispositions are a result of what the learners have experienced in SFSCS and its learning. They are socially constructed. Following this, I agree with Bishop's (2012) and Anderson's (2007) statements that learners' dispositions are dependent and constructed, based on how they perceive their SFSCS experiences within their environments, such as community, classroom, or with their peers. This is also confirmed by

Heyd-Metzuyanim (2013), Mbugua, Kibet, Muthaa and Nkonke (2012) and Boaler, William and Zevenbergen (2000) that low and high achievements of learners in an SFSCS and its learning are attributed to, and influenced primarily by, the learners' beliefs, attitudes and perceptions. These (beliefs, attitudes and perceptions) are not innate, they are socially constructed. The learners have been influenced by their background, the milieu of the school, the attitudes of their mathematics teachers, parents and social relations.

8.4 Juxtaposing the findings of the study

Figure 20 and Figure 25 present the comparison (similarities and differences) of patterns between the findings of ***learners' mindsets and their influence on learning*** and ***parents' and teachers' perceptions of learners' mindsets and their influence on learning*** within the cognitive, emotional and social dimensions, i.e. learners' mindsets and their influence on learning versus parents' and teachers' perceptions of learners' mindsets and their influence on learning at a glance.

In light of the analysis of findings, based on the ten learners and ensuing from the chart in Figure 22, the three dimensions (cognitive, emotional and social) are central as they connect each other; although the learners view the social dimension as the most important in the learning process of a SFSCS. It is noteworthy that the social dimension is crucial in influencing learners' achievements. However, the empirical data suggests that it is less in influencing learners' achievement. This is an attribution to the study's findings that almost all the low-achieving learners demonstrate a growth mindset within the social dimension. Therefore, the cognitive and emotional dimensions have the greatest influence on learner achievement; the learners who are high achievers are balanced and none of them view the cognitive dimension in fixed ways; and the learners who are low achievers lack more in the

cognitive and emotional levels (dimensions) and view the social level, therefore, as important.

Furthermore, regarding the analysis of findings based on the three teachers' and ten parents' perceptions about the ten learners' mindsets, the three dimensions (cognitive, emotional and social) are fundamental, because they link each other as well. However, the teachers' and ten parents' perceptions about the learners incline that social dimension is most essential in the learning process of an SFSCS. Furthermore, the teachers seem to show that learners are cognitively able, but not always emotionally positive and social support is seen as important in the learning process of a SFSCS. The parents show that their children (learners) can achieve cognitively and emotionally with support, in the learning process of a SFSCS.

8.5 Implications of the findings

The implications of the findings of learners' mindsets and their influence on learning and parents' and teachers' perceptions of learners' mindsets and their influence on learning are discussed below.

(a) Social needs are to be seen as supporting cognitively and emotionally. Most teachers believe that the learners need to be getting the support that helps them cognitively,but what they do not seem to be getting is that the cognitive is tied to the emotional. When you are giving the learners social support, you need to support them cognitively, as well as emotionally. As such, the social is meant to support cognitive and emotional development in the learning process of a SFSCS.

(b) High achievement is possible if the cognitive and the social are dealt with concurrently and positively. As such, if you view learners on the cognitive, emotional and social levels

with a growth mindset and they all work concurrently – which is what high achievers' profiles show, then high achievement can be achieved. In other words, we need to work with the cognitive, emotional and social all together all the time and keep in mind that, in each dimension, there are many variables. So, the cognitive, emotional and social are made up of a lot of things and is complex. If we can get those interplays within the different dimensions to work concurrently in a balanced way, then high achievement can be achieved.

(c) Mindsets are socially constructed, but they interplay between the cognitive, emotional and social and they emerge out of all of those. Simply put, mindsets are never only social, buy emerge out of the cognitive, emotional and social levels. Mindsets are fluid and dynamic and change all the time, which is the reason why people do not fit neatly into a growth mindset or fixed mindset.

(d) Social learning theories and mindsets theories should be viewed together to avoid mindsets being viewed as leading to innatist assumptions about learning possibilities. So, if we work with social learning theories, while seeing mindsets theories in relation to social learning theories and they are viewed together, then one of the effects that it can have is to prevent people from seeing mindsets as innate. In other words, if you work with social learning theories and mindsets theories together, it will help to move away from innatist assumptions. More so, if you work with social learning theories together with mindsets theories, then you will see that learning is complex and dynamic. It is about an interplay between internal and external forces that operate on all three dimensions. All of these things are dynamic and affect the constructing of mindsets.

(e) The findings of this study suggest the need for interventions for shifting learners' fixed mindset to growth mindset at the dimensions of cognitive and emotional, if we want to increase the learning curve for mathematics in South Africa.

8.6 Contributions of the study

While the deficit of the influence of mindsets on a strongly framed and classified subject using social learning theory is well-known in the South African and other literature relating to mathematics education, this study proposes a starting point for talking differently about mindsets and learning. Thus, this study contributes to the dialogue in two ways: describing and categorising potential levels (cognitive, emotional and social dimensions) into two crucial groupings (growth mindset and fixed mindset) and providing illustrative excerpts of these levels. This adds to an in-depth understanding of mindsets that the learners socially develop and their achievements in the learning process in South African high schools. In this way, this study makes both theoretical and methodological contributions to the field, which are basically located in the framework that emerged in the course of the analysis in this study.

8.6.1 Theoretical contribution

In this study, I draw on social learning theory as a theoretical lens to explore the influence of mindsets in the learning of strongly framed and strongly classified subjects, such as mathematics. Specifically, I use three elements (cognitive, emotional and social) of Illeris's social learning theory to frame the study. Within this frame, I brought in Bernstein's notion of a strongly framed and strongly classified subject and Dweck's mindsets theories (i.e., Dweck's distinction of the fixed mindset and growth mindset). Together, these enable understanding of the influence of mindset within the cognitive, emotional and social frame of a learner in the learning of a strongly framed and strongly classified subject. Thereafter, I

conceptualised a model (Figure 3.6) to show the key concepts in this study, which depicts that the cognitive and emotional dimensions are related to the learners' fixed and growth mindsets and are constructed socially in relation.

The Illeris's three dimensions of learning (cognitive, emotional and social) and Dweck's two types of mindsets (growth and fixed) provided the backbone for the development of this analytical framework. I found empirically that the interrelatedness among the three dimensions and the two kinds of mindsets is complex. More so, I put together the theoretical field of this study (i.e., the theories that underpin the study) and the empirical field (i.e., the collected data for this study) to develop the analytical framework. There was no analytical framework that brings together the mindsets theory and social learning theory. Therefore, the analytical framework developed in this study presents one of the major contributions in this field.

8.6.2 Methodological contribution

There are two significant methodological contributions from this study. Firstly, the study has contributed to characterising learning consisting of three elements or dimensions (cognitive, emotional and social) and their accompanying categories, through a case study approach, that are classified under two distinct types of mindsets (growth and fixed) in the school context, using South African setting. The categories are well explored in the context of resource constraints and are clearly defined for others to use, perhaps in similar contexts, where the learning process of a strongly framed and strongly classified subject reflects much of the South African context, for understanding the possibilities for learners' mindsets and their influence on learning.

Secondly, the analytical framework (bringing together the mindsets theory and social learning theory) can be used as professional development mechanisms to support the development of moves towards the improvement of learning of strongly framed and strongly classified subjects. As such, it is imperative to note that this study extends the existing knowledge by contributing to, as well as enhancing, a deeper understanding of mindsets and their implications for the learners' achievements.

The findings also provide some insights into how persistent issues, such as learners' low achievements facing an SFSCS, might be addressed through a focus on those aspects of mindsets and SFSCS learning. A focus on mindsets and learning provides a means of understanding, unpacking and addressing the learners' cognitive, emotional and social responses; their self-positioning concerning other learners and the surrounding discourses of an SFSCS, like mathematics and mathematical education. As such, the findings on mindsets will help people to understand better the qualities of improving the learners' skills, as well as mathematics learning and development (Darragh, 2016; Bishop, 2012; Anthony & Walshaw, 2009; Black, Mendick, & Solomon, 2009).

8.7 Limitations of the study

The main challenges encountered during the data collection are the following:

- I initially intended to conduct this study using at least two different high schools with at least fifteen mathematics learners, but this was not possible and confined me to one school and fewer participants.
- Having access to the high schools in Gauteng was almost impossible. I approached and gave letters to the appropriate authorities of seven high schools, which were suitable for the study for access into their schools for the data collection. Only two

high schools out of the seven replied as promised. The principal of one school replied to my letter, but turned it down after giving her a series of reminders. I was fortunate that the other high school's principal replied to my letter and graciously granted me access to her school. As such, this study was confined to one school.

- The learners' parents were not available for face-to-face interviews during the data collection, as initially proposed. This was due to their tight businesses, work schedules and other factors. This situation was remedied with the questionnaires, but no interviews with parents were conducted.
- Due to the complexities of race and gender, there was no adequate data on these factors. In terms of race and gender, the number of responses that I got was very few. The responses did not explore the elements in enough detail. The participants could have said more. I was also constrained in terms of time and resources to take this further. This is something I did not, unfortunately, pick up in the pilot study. I should have picked it up and perhaps could have asked different kinds of questions in this regard.
- One of the learners' mathematics teachers refused to participate in the study. She said she did not have time to participate. Her refusal, however, had no substantial effect on the data collected.

Regarding the limitations of this study, it is noteworthy at this point that some of the disadvantages of using a qualitative case study method are that it is time-consuming and requires a lot of resources for data collection. I would have liked to observe the learners in their classrooms and study them for more than the time allowed, in order to have more exhaustive data to further validate the findings of this study; however, time and financial constraints did not permit it.

8.8 Recommendations

The following recommendations are made, based on the conclusions of this study:

1. Support in school and the home of the learners is critical in mathematics learning and achievement.
2. People need to be socialised into the understanding that mindsets, beliefs, attitudes, ability and other components of learners' Mathematical Identities are not natural [God-given]. They arise from the learners' experiences [human-made]. We need to understand that everyone is capable of learning mathematics, given the right kind of opportunity and/or environment.

This study alone may not change any kind of contradicting views some people have on learning a strongly framed and strongly classified subject, like mathematics, as well as learners' mindsets and their implications. Given this reality, it will be useful for further studies to be carried out in other provinces in South Africa and in other countries. This study used two research instruments for the data collected. Other research instruments could be used to make a comparison of the data, verify the results and subsequently generate conclusion(s).

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Appendix A

Wits School of Education

27 St Andrews Road, Parktown, Johannesburg, 2193 Private Bag 3, Wits 2050, South Africa. Tel: +27 11 717-3064 Fax: +27 11 717-3100 E-mail: enquiries@educ.wits.ac.za Website: www.wits.ac.za

01 March 2018

Student Number: 0711526H

Protocol Number: 2017ECE016D

Dear Abel Uwerhiavwe

Application for Ethics Clearance: Doctor of Philosophy

Thank you very much for your ethics application. The Ethics Committee in Education of the Faculty of Humanities, acting on behalf of the Senate, has considered your application for ethics clearance for your proposal entitled:

Relationships between Learners' Mathematical Identities and their Mathematics Learning

The committee recently met and I am pleased to inform you that **clearance was granted**.

Please use the above protocol number in all correspondence to the relevant research parties (schools, parents, learners etc.) and include it in your research report or project on the title page.

The Protocol Number above should be submitted to the Graduate Studies in Education Committee upon submission of your final research report.

All the best with your research project.

Yours sincerely,

MMaseko

Wits School of Education

011 717-3416

cc Supervisor – Prof. N Carrim

Appendix B

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	**03 August 2018**
Validity of Research Approval:	**05 February 2018 – 28 September 2018** **2018/222**
Name of Researcher:	**Uwerhiavwe A.**
Address of Researcher:	**40 Cookham Road,**
	Auckland Park
	Johannesburg, 2092
Telephone Number:	**063 494 6024 065 883 3566**
Email address:	**uwerhiavweabel@gmail.com**
Research Topic:	**Relationships between Learners' Mathematical Identities and their Mathematics Learning.**
Type of qualification	**Doctor of Philosophy (Education)**
Number and type of schools:	**Two Secondary Schools.**
District/s/HO	**Johannesburg North, Johannesburg West.**

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

15/08/2018

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

1. *The District/Head Office Senior Manager/s concerned must be presented with a copy of this*

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.

2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*
4. *A letter / document that outline the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
5. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
6. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
7. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
8. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
9. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
10. *The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
11. *The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
12. *On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
13. *The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.*
14. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

.....

Mr Gumani Mukatuni
Acting CES: Education Research and Knowledge Management

DATE: 15/08/2014

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
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Appendix C

Information Letters and Consent Forms

Principal:

Wits School of Education: Mathematics Education
27 Andrews Road, Parktown, Private Bag X3. Wits 2050. (011) 717-1000
March 01, 2018

Dear Sir/Madam,

Request to Collect Data at Your School

My name is Abel Uwerhiavwe and I am a PhD student in the School of Education at the University of the Witwatersrand. I am doing research on the **Analysis of the Influence of Mindsets in a Strongly Framed and Classified Subject Using Social Learning Theory.** My supervisors are Professor Nazir Carrim and Dr. Lawan Abdulhamid.

My research involves the study of a strongly framed and classified subject and its implications for learning in the context of mathematics. In the study, I will initially give a questionnaire to the Grade 9 learners who have agreed to participate; this exercise will be for 30 minutes including explanations for learners. I will then select ten Grade 9 learners of SFSCS and the teachers and parents of the ten Grade 9 learners will also be participants based on their consent. There will be formal interviews of the mathematics learners, learners' mathematics teachers and learners' parents. The interviews for each mathematics learner, mathematics teacher and mathematics learners' parents will be for a period of around 30 minutes. Based on the consent of the participants, I will audio record the interviews of the learners, teachers and learners' parents. I have chosen your school because it is accessible, it is a specialized school that has learners specialized in mathematics and science and its proximity to me as well as the Wits School of Education. As such, I am inviting this school to participate in this research.

Participation in this research is voluntary. The research participants will not be advantaged or disadvantaged in any way. They will be reassured that they can withdraw their permission at any time during this project without any penalty. There are no foreseeable risks in participating in this study. The participants will not be paid for this study. The names of the research participants and the identity of the school will be kept confidential in all academic writing about the study. Your individual privacy will be maintained in all published and written data resulting from the study. The research electronic data will be stored safely on a password-protected computer and all hard copies of the raw data will be stored in a lock-up cabinet in a lock-up cabinet at the Wits School of Education. I and my supervisors will be the only people with access to the data. After the mandatory storage period of three to five years after completion of the project, all data will be appropriately destroyed. The results of the research will be used for academic purposes (including books, journals and conference proceedings) and a summary of findings will be made available to participants, the school and the GDE.

If you are willing to give permission for participants in your school to be part of my research project, I would ask that you complete and sign the attached consent form and return it to me. If you require any further information, please do not hesitate to contact me. I look forward to your response as soon as it is convenient.

Yours sincerely,

Abel Uwerhiavwe (065 883 3566)

Principal's Consent Form

Please fill in and return this consent form by indicating your willingness for teachers, learners and learners' parents in your school to participate in the research titled: **Analysis of the Influence of Mindsets in a Strongly Framed and Classified Subject Using Social Learning Theory**; by Abel Uwerhiavwe, a PhD candidate, Wits School of Education. My supervisors are Professor Nazir Carrim and Dr. Lawan Abdulhamid.

I .....of
(Principal's full name)

……
(School's full name)

have read and understand the letter requesting consent to conduct research at this school: **Yes/ No***

I give my consent to Abel Uwerhiavwe to conduct the specified research in the school: **Yes/ No***

Signature: …… Date: ……..

***Please circle your choice of answer**

Learners:

Wits School of Education: Mathematics Education
27 Andrews Road, Parktown. Private Bag X3, Wits 2050. (011) 717-1000
March 01, 2018

Researcher: Mr. Abel A. Uwerhiavwe
Supervisors: Professor Nazir Carrim and Dr. Lawan Abdulhamid

Dear Learner,

Request to Participate in My Research

My research involves the study of mindsets and learning. In the study, I will give a questionnaire to the Grade 9 learners who have agreed to participate; this will be for 30 minutes including explanations for the learners. I will then choose ten Grade 9 learners of mathematics. There will be interviews with the learners. The interviews will be for around 30 minutes. I will audio record the learners' interviews.

You do not have to take part in this research, but I would like you to choose to do so. You will not be advantaged or disadvantaged in any way. You can withdraw your permission at any time during this project. There are no foreseeable risks in participating in this study. You will not be paid for this study. The names of learners and the school will be kept confidential. Your individual privacy will be maintained. The research electronic data will be stored safely on a password-protected computer and all hard copies of the raw data will be stored in a lock-up cabinet at the Wits School of Education.

If you are willing to volunteer for this research project, please complete and sign the attached consent form and return it to me. If you need any further information, please contact me. I look forward to your response as soon as it is convenient.

Yours sincerely,

Abel Uwerhiavwe (065 883 3566)

Learner's Consent Form

Please fill in and return this consent form by indicating a willingness to participate in research titled: **Analysis of the Influence of Mindsets in a Strongly Framed and Classified Subject Using Social Learning Theory**; by Abel Uwerhiavwe, a PhD candidate, Wits School of Education. My supervisor is Professor Nazir Carrim and Dr. Lawan Abdulhamid.

My name is ……..., I give my consent for the following:

	Circle One
Permission to be interviewed	
I would like to be interviewed for this study.	**Yes/No**
I know that I can stop the interview at any time and don't have to answer all the questions asked.	**Yes/No**
Permission for questionnaire	
I agree to fill in a question and answer sheet for this study.	**Yes/No**
Permission to be audiotaped	
I agree to be audiotaped during the interview or observation lesson	**Yes/No**
I know that the audiotapes will be used for this project (including books, journals and conference proceedings) only	**Yes/No**

Informed Consent

I understand that:

- my name and information will be kept confidential and safe and that my name and the name of my school will not be revealed.
- I do not have to answer every question and can withdraw from the study at any time.
- I can ask to not be audiotaped.
- all the data collected during this study will be destroyed within 3-5 years after completion of my project.

Sign: …….. Date: ……..

***Please circle your choice of answer**

Learners' Teachers:

Wits School of Education: Mathematics Education
27 Andrews Road, Parktown, Private Bag X3, Wits 2050. (011) 717-1000
March 01, 2018

Dear Sir/Madam,

Request for Your Participation in Research

My name is Abel Uwerhiavwe and I am a PhD student in the School of Education at the University of the Witwatersrand. I am doing research on the Analysis of the Influence of Mindsets in a Strongly Framed and Classified Subject Using Social Learning Theory. My supervisor is Professor Nazir Carrim and Dr. Lawan Abdulhamid.

My research involves the study of a strongly framed and classified subject and its implications for learning in the context of mathematics. In the study, I will initially give a questionnaire to the Grade 9 learners who have agreed to participate; this exercise will be for 30 minutes including explanations for learners. I will then select ten Grade 9 learners of mathematics and the mathematics teachers and parents of the ten Grade 9 learners will also be participants based on their consent. There will be formal interviews of the learners, learners' mathematics teachers and parents. The interviews for each learner, teacher and learners' parents will be for a period of around 30 minutes. Based on the consent of the participants, I will audio record the interviews of the learners, teachers and learners' parents.

Participation in this research is voluntary. The research participants will not be advantaged or disadvantaged in any way. They will be reassured that they can withdraw their permission at any time during this project without any penalty. There are no foreseeable risks in participating in this study. The participants will not be paid for this study. The names of the research participants and the identity of the school will be kept confidential in all academic writing about the study. Your individual privacy will be maintained in all published and written data resulting from the study. The research electronic data will be stored safely on a password-protected computer and all hard copies of the raw data will be stored in a lock-up cabinet at the Wits School of Education. I and my supervisors will be the only people with access to the data. After the mandatory storage period of three to five years after completion of the project, all data will be appropriately destroyed. The results of the research will be used for academic purposes (including books, journals and conference proceedings) and a summary of findings will be made available to participants, the school and the GDE.

If you are willing to give permission for me to interview you and observe your classes in your school, I would ask that you complete and sign the attached consent form and return it to me. If you require any further information, please do not hesitate to contact me. I look forward to your response as soon as it is convenient.

Yours sincerely,

Abel Uwerhiavwe (065 883 3566)

Teacher's Consent Form

Please fill in and return this consent form by indicating a willingness to participate in research titled: **Relationships between Learners' Mathematical Identities and their Mathematics Learning** by Abel Uwerhiavwe, a PhD candidate, Wits School of Education. My supervisors are Professor Nazir Carrim and Dr. Lawan Abdulhamid.

I, …….. give my consent for the following:

	Circle one
Permission to be audiotaped	
I agree to be audiotaped during the interview.	**Yes/No**
I know that the audiotapes will be used for this project (including books, journals and conference proceedings) only	**Yes/No**
Permission to be interviewed	
I would like to be interviewed for this study.	**Yes/No**
I know that I can stop the interview at any time and don't have to answer all the questions asked.	**Yes/No**

Informed Consent

I understand that:

- my name and information will be kept confidential and safe and that my name and the name of my school will not be revealed.
- I do not have to answer every question and can withdraw from the study at any time.
- I can ask to not be audiotaped.
- all the data collected during this study will be destroyed within 3-5 years after completion of my project.

Sign: …… Date: …….

***Please circle your choice of answer**

Learners' Parents:

Wits School of Education: Mathematics Education
27 Andrews Road, Parktown, Private Bag X3, Wits 2050. (011) 717-1000
March 01, 2018

Dear Sir/Madam,

Request for You and Your Child to Participate in a Research

My name is Abel Uwerhiavwe and I am a PhD student in the School of Education at the University of the Witwatersrand.

My research involves the study of mindsets and learning. In the study, I will initially give a questionnaire to the Grade 9 mathematics learners who have agreed to participate; this will be for 30 minutes including explanations for learners. I will then select ten Grade 9 learners of mathematics and parents of the ten Grade 9 learners will also be participants based on their consent. There will be formal interviews of the learners, learners' mathematics teachers and parents. The interviews for each learner, teacher and learners' parents will be for a period of around 30 minutes. Based on the consent of the participants, I will audio record the interviews of the learners and learners' parents.

You do not have to take part on this research, but I would like you to choose to do so. You and your child will not be advantaged or disadvantaged in any way. You can withdraw your permission at any time during this project. There are no foreseeable risks in participating in this study. You will not be paid for this study. The names of learners, yourself and the school will be kept confidential. Your individual privacy will be maintained. The research electronic data will be stored safely on a password-protected computer and all hard copies of the raw data will be stored in a lock-up cabinet at the Wits School of Education.

If you are willing to give permission for your child and for you to be part of my research project, I would ask that you complete and sign the attached consent form and return it to me. If you require any further information, please do not hesitate to contact me. I look forward to your response as soon as it is convenient.

Yours sincerely,

Abel Uwerhiavwe (065 883 3566)

Learners' Parents' Consent Form

Please fill in and return this consent form by indicating a willingness to participate in research titled: **Analysis of the Influence of Mindsets in a Strongly Framed and Classified Subject Using Social Learning Theory** by Abel Uwerhiavwe, a PhD candidate, Wits School of Education. My supervisors are Professor Nazir Carrim and Dr. Lawan Abdulhamid.

I, ……..., the parent of …… hereby give my consent for the following:

Circle one

Permission to interview my child

I agree that my child may be interviewed for this study.
I know that he/she can stop the interview at any time and doesn't have to answer all the questions asked. **Yes/No**

Permission for questionnaire

I agree that my child maybe fill in a question and answer sheet for this study. **Yes/No**

Permission to audiotape my child

I agree that my child may be audiotaped during the interview. **Yes/No**
I know that the audiotapes will be used for this project (including books, journals and conference proceedings) only. **Yes/No**

Permission for questionnaire

I agree to fill in a question-and-answer sheet for this study. **Yes/No**

Informed Consent

I understand that:

- my name and my child's name and information will be kept confidential and safe and that my name and the name of my school will not be revealed.
- I or my child does not have to answer every question and can withdraw from the study at any time.
- my child can ask to not be audiotaped.
- all the data collected during this study will be destroyed within 3-5 years after the completion of my project.

Sign: …….. Date: ……..

***Please circle your choice of answer**

Appendix D

Learners' Narrative Schedule

Name:	**Race:**	**Gender:**
Previous Mathematics Exam Score:	**Grade:**	**Name of Mathematics Teacher:**

1. How do you feel if you do well on a mathematics test or examination?

2. How do you feel if you do badly on a mathematics test or examination?

3. Do you often give up in mathematics lessons? Yes or No. If yes/no, why?

4. When you find mathematics easy and enjoyable, how do you feel?

5. When you find mathematics difficult, how do you feel?

6. "Some people are just born clever in mathematics". Do you think that is true or not? Explain.

7. "I can get better in mathematics and its learning through hard work". Is that true for you or not? Explain.

8. "My performance in mathematics and its learning is something I can develop". Is that true for you or not? Explain.

9. "I don't like doing anything difficult in mathematics lessons". Is that true for you or not? Explain.

10. "Support from people will help me to understand mathematics more". Is that true for you or not? Explain.

Appendix E

Learners' Interview Schedule

- This interview is voluntary and confidential.
- You can refuse to answer any question that you do not want to answer.
- You may ask me to clarify any of the questions that you do not understand.
- Please be précised as you can; be audible as well.

1. What is your favorite subject in school? Why?
2. Do you like the subject, mathematics?
3. Can you tell me about your beliefs about mathematics? Please explain why?
   - Can every learner do mathematics?
   - Is mathematics understandable or not?
   - Is mathematics challenging?
4. Can you tell me about your interest in mathematics?
   - Do you find mathematics interesting? Why?
5. Please tell me about your confidence in mathematics? Explain why?
   - Do you feel competent to do mathematics?
   - Do you pass mathematics examinations easily?
   - Do you think that you are good at mathematics? Why?
   - Do you think that you will pass your next mathematics exam (final)?
6. What can you say about the kind of mathematics you do in the classroom?
   - Does it show that mathematics learning is a waste of time or it is useful? Why?
7. Are you committed to mathematics? Please explain how?
   - Do you have a sense of belonging (feels accepted and comfortable) in the mathematics classroom? Why?
   - Can you tell me some of your attitudes towards mathematics learning?
   - Do you feel important in the mathematics classroom?
   - How is your performance in mathematics? Please explain.
8. Are you determined in learning mathematics?
9. Does your mathematics teacher entertain questions from you in the class?
10. Is mathematics learning fun or boring? Explain why?
11. What would your ideal mathematics classroom look like?
12. Do you feel happy whenever it is time for mathematics class?
13. Do you read and practice mathematics?
14. Do you find mathematics easy or difficult? Why?
15. What mathematics topic do you enjoy the most and the least? Explain why?
16. How useful is mathematics for you at the moment?
17. Would you like to be engaged in the study of mathematics in the future? Please explain why?

18. Will mathematics be important for your future career?
19. Have your views on mathematics changed from when you were younger to now? If so, what things have caused this change?
20. Are boys naturally better in mathematics than girls?
21. Must you be very intelligent to learn mathematics?
22. If you want to do well (better) in mathematics, what can you do?
    - Does making mistakes help? Why? Please explain.
    - What does making a mistake means to you in mathematics? Please explain?
    - Does doing difficult problems help? Please explain.
    - Are you doing very well, well, average or not well?
23. Have you ever thought of race in mathematics learning? If yes? Can you share your thoughts?
24. Does being intelligent to learn mathematics has any relationship with your race? If yes/no, why?
25. Must you have to be a "special" person in order to be good at mathematics? Explain.
26. Is there a good teacher/learner relationship with your mathematics teacher? If yes/no, how would you describe your relationship with the mathematics teacher?
27. Please tell me about your experience in mathematics learning at the moment.
28. How will you describe yourself in the learning of mathematics? Why?
29. When you are stuck on a mathematics problem or when you get something wrong, what do you do or say?
    - What about other learners? Why?
    - What about your mathematics teacher? Why?
    - What about your family members? Why?
30. Do you do your mathematics assignments, that is, class work and homework?
31. Do your peers (classmates/other learners) help you in any way help you when you need assistance in mathematics learning? Explain how?
    - Do your peers (classmates/other learners) assist you in doing your mathematics assignments (class work)?
    - Do you assist your peers (classmates/other learners) in doing their mathematics assignments (class work)?
32. Do any of your family members (siblings, parents, or guidance) contribute to your mathematics learning? Explain how?
    - Do any of your family members (siblings, parents, or guidance) assist you in doing your mathematics assignments (homework)?
    - Do you assist any of your family members (siblings) in doing his/her mathematics assignments (homework)?
33. What do you often say about mathematics and its learning? Why?
    - What about other learners? Why?
    - What about your mathematics teacher?
    - What about your family members?
    - How has what they (other learners, teacher, or family members) said made you think about mathematics?

34. Is there anything that you think could be changed to make mathematics learning in the classroom fun and educational as well?
35. How would you compare mathematics to other subjects?
    - Do you find other subjects fun or boring? Explain why?
    - What subject do you enjoy most? Explain why?
    - What subject do you enjoy least? Explain why?
36. Is there anything else you would like to say about mathematics and its learning?
37. Is there any other challenge you may want to say?

Thank you!

Other interview questions were expected to emerge from the learners' responses to the above questions in order to elicit retrospective verbalizations from the learners. Questions that were asked were related to the following: (i) Can you explain more, please? (ii) What made you think so? (iii) How did you know that? (iv) Why?

Appendix F

Teachers' Interview Schedule

- This interview is voluntary and confidential.
- You can refuse to answer any question that you do not want to answer.
- You may ask me to clarify any of the questions that you do not understand.
- Please be précised as you can; be audible as well.

1. What is your area of specialization (subject you teach)?
2. What are your qualifications?
3. Are the classrooms conducive for teaching and learning of mathematics?
4. How often do you teach for a week?
5. Do you have enough time for your lessons?
6. Do you enjoy teaching mathematics?
7. Are you interested and motivated in teaching mathematics?
8. What method of instructions do you use in mathematics teaching?
9. Do you entertain questions from your learners in the class?
11. Are your learners interested and motivated in your classes?
12. Are your learners committed to mathematics learning? Please explain.
13. Are your learners regular to class?
14. Do your learners concentrate/pay attention in the class?
15. Please tell me what type of mathematics learners your learners are. Please explain.
    - Do your learners show sign(s) of having confidence in mathematics? If yes/no, in what ways, please give some examples of such situations?
    - How do your learners view the learning of mathematics?
16. How do your learners relate with each other during mathematics learning? Please explain.
    - What about helping each other?
    - Do your learners have a sense of belonging (feels accepted and comfortable) in the mathematics classroom? Explain why?
17. How do your learners handle difficult problems in mathematics?
    - What happens when your learners get stuck in mathematics problems?
    - Do they continue trying? Please explain.
    - Do they ask for help? Please explain.
    - If they made a mistake, what is their reaction(s)? Please explain
    - Do they complete their mathematics tasks? Please explain?
18. What do you think about your learners' beliefs towards mathematics and its learning?
    - Do the learners say that it is difficult? Please explain.
    - Do the learners say that it is fun or boring? Please explain.
    - Do the learners say that it is interesting? Please explain.
    - Do the learners say that it is useful or a waste of time? Please explain.
19. Please, how will you describe your learners in the learning of mathematics?
    - Can you tell me about your learners' performances in mathematics?
    - How will you rate your learners' performances in mathematics?

- Are your learners performing very well, well, average, or below average? Please explain

20. Do boys and girls learn mathematics differently?
21. Are boys naturally better in mathematics compared to girls?
22. Does race influence intelligence? If yes/no, please explain why.
24. Do you consider race as an attribute to the effective learning of mathematics? If yes/no, explain why.
25. Are learners born with a special talent in mathematics? Explain.
26. What are the attitudes of your learners toward mathematics and its learning?
27. Is there a good teacher/learners' relationship? If yes/no, how would you describe your relationship with your learners in the mathematics classes?
28. Do your learners' family members give you support/assistance regarding the learning of mathematics of their child(ren) whenever the need arises?
29. Is there anything else you would like to say about your learners?
30. Is there any other challenge you may want to say?

Thank you!

Other interview questions were expected to emerge from the teachers' responses to the above questions in order to elicit retrospective verbalizations from the teachers. Questions that were asked were related to the following: (i) Can you explain more, please? (ii) What made you think so? (iii) How did you know that? (iv) Why?

Appendix G

Learners Parents' Questionnaire

- This questionnaire is confidential.
- You can refuse to answer any question that you do not want to answer.
- Please kindly circle either **Yes or No** and **fill in the blank spaces** as well.
- Please be precised as you can.

1. Does your child read and practice mathematics at home? **Yes/No**.
2. Does your child do his/her mathematics assignments – homework regularly? **Yes/No**.
3. Do you or any of your family members contribute to your child's mathematics learning?

Yes/No. If Yes, please explain how. If No, why? ……

……

……

- Do you or any of your family members assist in doing his/her mathematics assignments (homework)? **Yes/No**.
- Does he/she assist any of your family members (siblings) in doing his/her mathematics assignments (homework)? **Yes/No**.

4. Is your child willing, determined, motivated, or happy in reading and practicing mathematics? **Yes/No**.
   - Does he/she enjoy it? **Yes/No**.
   - Is he/she interested in it? **Yes/No**.
   - Is he/she competent in it? **Yes/No**.
   - Does he/she show sign(s) of having confidence in it? **Yes/No**.
5. Has your child discussed with you about his/her mathematics learning experiences? **Yes/No**. If **Yes**, what? If **No**, can you say why?

……

……

……

6. What do you think about your child's beliefs about mathematics learning?

……

……

……

- Does he/she say that it is difficult? **Yes/No**. Please explain:

……

……

- Does he/she say that it is fun or boring? **Yes/No**. Please explain: ……
  ……

- Does he/she say that it is interesting? **Yes/No**. Please explain: ……
  ……
  ……
- Does he/she say that it is useful or a waste of time? **Yes/No**. Please explain:
  ……
  ……

7. Is your child committed to Mathematics? **Yes/No**. Please explain how:
   ……

   ……

   ……
   - Can you tell me some of his/her attitudes towards mathematics?……
     ……
     ……
8. Please, what can you say about race and mathematics learning? What are your child's views about it, if any?……

   ……

   ……
9. What can you tell me about gender mathematics learning, please? What are your child's views about it, if
   any?……

   ……

   ……
10. How would you describe your child's achievement in mathematics?
    ……

    ……

    ……
    - Can you tell me about his/her performances in mathematics?
      ……
      ……
    - How will you rate his/her performances in mathematics?
      ……
      ……
    - Is he/she performing very well, well, average, or below average? ……
      Please explain: ……
      ……

11. Are you impressed with your child's achievement in mathematics learning? **Yes/No**. If **Yes/No,** why? ……

    ……..

    ……
12. Are you able to support and provide your child with all his/her needs to effectively learn mathematics? **Yes/No**. Explain, please: …….....

    ……

    ……..
13. Does your child need to be "special" in order to be good at mathematics? **Yes/No**. Please explain:..……..…….

    ……

    ……..
14. What are your child's views about his/her learning of mathematics?……

    ……..

    ……..

    ……..

    ……..
15. How will you describe your child in the learning of mathematics at the moment?……

    ……..

    ……..

    ……..

    ……..

16. Will mathematics be useful to your child's future career? **Yes/No**.
17. Will you love your child to be engaged with mathematics in the future? If **Yes/No**, why?……..

    ……..

    ……..
18. Do you like mathematics? If **Yes/No**, please explain why?…….

    ……..

……

……

19. How would you describe your other child(ren) in the learning of mathematics?……

……

……

……

20. Is there anything else you would like to say about your child doing mathematics? **Yes/No.** If Yes, what?……

……

……

……

21. Is there any other challenge you may want to say? If **Yes/No**. What?

……

……

……

……

Thank you!