

**An exploration of the mathematical learner identities of high school learners who participated in after school mathematics clubs in primary school**

A thesis submitted in fulfilment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

of

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by

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March 2021

## DECLARATION

I, Wellington Munetsi Hokonya, declare that this thesis entitled An exploration of the mathematical identities of high school learners who participated in after school mathematics clubs in primary school represents my original work and ideas. Where ideas from other writers are used, these are acknowledged in full using full references and in accordance with the university's referencing guidelines. It is being submitted for the degree of Doctor of Philosophy at Rhodes University, Makhanda. It has not been submitted for any degree or examination at any other university.

Signature:

A handwritten signature in black ink, appearing to read 'W. Munetsi Hokonya', written in a cursive style.

Wellington Munetsi Hokonya

Date: 15 March 2021

## **Abstract**

This study focuses on understanding mathematics learner identities of high school learners who participated in the South African Numeracy Chair Project after school mathematics clubs, an environment that afforded different mathematics identities from the traditional South African classroom. Mathematics learner identities feature prominently in current research on mathematics education because they affect whether and how learners engage in mathematics. They play a critical role in enhancing (or detracting from) learners' attitudes, dispositions, emotional development, and general sense of self as they learn mathematics. Development of positive learner mathematical identity is therefore useful in making learners commit to their mathematics work.

South African primary mathematics education is described as being in a state of crisis, and various programmes are being implemented to develop intervention models to improve quality and ensure the effective teaching and learning of primary mathematics. The South African Numeracy Chair Project initiative at Rhodes University provides for longitudinal research and development programmes with primary mathematics teachers and learners from previously disadvantaged schools, in order to find ways of mitigating the crisis. The after school mathematics clubs provide extra-curricular activities focused on developing a supportive learning community where learners' active mathematical participation, engagement, enjoyment, and sense making are the focus. The clubs provide a supportive learning environment that is different to the traditional classroom and in which learners can participate actively and freely in mathematical activities.

The study explores the nature of mathematics learner identities as learning trajectories that connect the past and future in negotiation of the present. It also seeks to discover how primary school club participation and experiences feature in the learners' mathematical identities.

The study employs two theoretical frameworks to analyse qualitative data that was gathered in the form of spoken and written stories, by 14 learners who participated in the after school mathematics clubs in primary school. The stories covered learners' engagement in mathematics in different landscapes of practice that promoted the construction of different learner mathematical identities.

A close analysis of the qualitative data revealed that learners' mathematical identities are heavily influenced by the values that were foregrounded in the after school mathematics clubs. The clubs valued hard work and encouraged learners to ask for assistance when in doubt. In line with the club ethos, the learners storied resilience and hard work in their narratives. In addition, although many learners storied Mathematics as difficult in high school, they chose to continue taking the subject.

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## **DEDICATION**

This thesis is dedicated to my parents, who have always believed I could do it. I have done it!!

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# CHAPTER 1

## INTRODUCTION

### 1.1 INTRODUCTION

My research recognises the centrality of mathematics learner identity [MLI] in the learning of mathematics in different landscapes of practice. According to Sfard and Prusak (2005b), MLI provides a powerful bridge between learning and cultural context. In mathematics education in particular, identity has been useful in exploring – without falling into cognitive deficit discourses – why so many learners disengage from mathematics (Graven & Heyd-Metzuyanim, 2019). In this chapter, I provide some background on schooling in South Africa and offer a rationale for my research. I also formulate the problem statement and research questions that inform the study.

The purpose of this study is to explore the nature of the MLIs of underprivileged high school learners who participated in after school mathematics clubs in primary school. The study analyses their stories with a particular focus on how their participation in after school mathematics clubs features (or does not feature) in the construction of their current mathematics identities and practices.

### 1.2 RATIONALE

The rationale for the study is the need to ascertain the MLIs of high school learners who participated in after school mathematics clubs in primary school. Many studies (Boaler, William, & Brown, 2000; Bishop, 2012; Walshaw, 2013; Hall, Towers, & Martin, 2018) have shown that MLIs are pertinent to the understanding of learners' participation and performance in mathematics in school and after they leave school. Hall et al. (2018, p. 183) assert that “a subset of educational research addressing identity issues concerns mathematical identities, a topic that has become increasingly popular in mathematics education research.” The term “identity” in this study refers to the “collections of stories about persons or, more specifically, as those narratives about individuals that are *reifying*, *endorsable*, and *significant*.” (Sfard & Prusak, 2005b, p. 16). Identities are important to consider in mathematics education “because they affect whether and how we engage in activities, both mathematical and otherwise, and Boaler (2000) argues that MLIs influence learners' continued learning of the subject. As learners move through school, they come to learn who they are as mathematics learners through their experiences in mathematics classrooms and interactions with teachers (Anderson, 2007).

Boaler noted that although certain learners were generally successful in mathematics, they experienced an important conflict between the practices in which they engaged and their developing identities as people. Regardless of their good performance in mathematics, they talked about their dislike of the subject and their plans to abandon it as soon as they were able to. This phenomenon is typically attributed to the negative identities that result from the application of traditional pedagogical approaches in the teaching of the subject. Learners are positioned as passive receivers of knowledge, engaging in practices that leave no room for their own interpretation or agency (Boaler, 2000). They therefore experience their identity in respect of mathematics as a negative one. Alternative pedagogies can spur learners into wanting to engage more in mathematics, regardless of their performance. In other words, such teaching and learning methods lead to the evolution of a positive MLI. Learners in my study were exposed to after school mathematics clubs in which teaching pedagogies that privileged participative learning were deliberately promoted, on the assumption that this would support the building of positive learning identities. I therefore seek to understand the MLI journeys of these learners, from the start of their schooling, through participation in these clubs in some primary grades, to the present and into the future.

Boaler (2000) argues that MLIs influence learners' continued learning of the subject. As learners move through school, they come to learn who they are as mathematics learners through their experiences in mathematics classrooms and interactions with teachers (Anderson, 2007). Boaler noted that although certain learners were generally successful in mathematics, they experienced an important conflict between the practices in which they engaged and their developing identities as people. Regardless of their good performance in mathematics, they talked about their dislike of the subject and their plans to abandon it as soon as they were able to. This phenomenon is typically attributed to the negative identities that result from the application of traditional pedagogical approaches in the teaching of the subject. Learners are positioned as passive receivers of knowledge, engaging in practices that leave no room for their own interpretation or agency (Boaler, 2000). They therefore experience their identity in respect of mathematics as a negative one. Alternative pedagogies can spur learners into wanting to engage more in mathematics, regardless of their performance. In other words, such teaching and learning methods lead to the evolution of a positive MLI. Learners in my study were exposed to after school mathematics clubs in which teaching pedagogies that privileged participative learning were deliberately promoted, on the assumption that this would support the building of positive learning identities. I therefore seek to understand the MLI journeys of

these learners, from the start of their schooling, through participation in these clubs in some primary grades, to the present and into the future.

MLI research is important because it provides education practitioners with insight into how learners negotiate or re-negotiate their mathematical identities as they participate in various landscapes of practice (Wenger-Trayner & Wenger-Trayner, 2015). The concepts of negotiation and re-negotiation illuminate the fluid nature of identities.

The broad concept of identity accounts for how a person understands his or her relationship to the world, how that relationship is constructed across time and space, and what possibilities the future holds for it (Norton, 2000). Put in another way, whoever we believe ourselves to be exerts a powerful influence on how we interact, engage, behave, and learn (Wenger, 1998; McCarthy & Moje, 2002). “Identity is also the construct with the help of which one answers both the question of what is unique to a person and of what makes this person a member of a kind” (Sfard, 2019, p. 556). The relationship that learners of mathematics have with the subject informs their engagement with mathematical activities in school and even when they eventually leave school and enter the world of employment (Boaler, 2000; Boaler & Selling, 2017). Sfard and Prusak (2005b, p. 15) reiterate the importance of identity research when they stress that:

together with the acceptance of identity as the pivotal notion of the new research discourse comes the declaration that human beings are active agents who play decisive roles in determining the dynamics of social life and in shaping individual activities.

Furthermore, identity is noted for playing the role of a conceptual bridge between learning and its cultural setting (Sfard & Prusak, 2005b) and also:

[as] the epitome of one’s special ways of being in the world, identity must be reflective of this person’s thinking and feeling; as a construct that portrays people as representatives of existing socio-cultural categories, it is expected to be helpful in figuring out how the individual emerges from the social and the other way round, how individual ways of acting feed into those of collectives (Sfard, 2019, p. 556).

Identity construction results from learners’ participation and engagement in various learning communities that they pass through in their learning trajectory (Wenger, 1998) from the past (primary school) to the present (secondary school) and into the future. Insofar as this study focuses on learners’ MLIs, it seeks to trace their mathematics learning trajectories. As Wenger (1998, p. 163) notes: “An identity is a trajectory in time that incorporates both past and future into the meaning of the present”. My study foregrounds learners’ narratives of mathematics identity from the start of their schooling, through their participation in the after school mathematics clubs to their future imagined identities. MLIs are thus broadly understood as

learners' self-understanding and their sense of self as mathematics participants, operationalised as stories they tell.

Summing up, Walshaw (2013) explains that identities are produced through social interaction, daily negotiations, and within particular contexts and arrangements that are already heavily laden with the meanings of others. Roth (2004) characterises identity as man-made and constantly created and re-created in interactions among people. Yet, as Oppland-Cordell and Martin (2015) observe (writing about the American context), "little is known about marginalised learners' perspectives of how their identity development and participation influence one another" (p. 22) in their learning of mathematics. This study seeks to address this subject by exploring the MLIs of high school mathematics learners from underprivileged socio-economic communities. It is hoped that it will contribute to the growing body of literature that highlights learning as changing identity, as well as to policy and practice in after school mathematics clubs in primary schools.

### **1.3 BACKGROUND TO THE STUDY**

Since the inception of the democratically elected government in South Africa in 1994, the country has attained almost universal access to basic education, with over 98% of learners attending primary school (Statistics South Africa, 2010). According to Sayed (2001), the need for rectification and parity in all aspects of education was a necessary imperative in a new, democratic education system. Yet although there has been an increase in physical access to schooling, there has been no comparable increase in epistemological access, with the majority of learners not achieving the required outcomes in mathematics (Fleisch, 2008). Rather, South African mathematics education is widely acknowledged to be in a state of crisis (Fleisch, 2008).

According to Spaull (2011), mathematics achievement in South Africa is abnormally low, as evidenced by sustained poor performance across international, regional and national assessments. These have shown that primary learners cannot execute mathematics tasks at the appropriate grade levels and have a poor grasp of elementary, foundational mathematical concepts (Fleisch, 2008; Department of Basic Education [DBE], 2008; Southern and Eastern African Consortium for Monitoring Educational Quality [SACMEQ], 2010; Askew, Venkat, & Matthews, 2012; Reddy, et al., 2016). The Eastern Cape Province in South Africa, where this study was carried out, was the second worst performing province in the National Senior Certificate [NSC] Mathematics examinations in 2015, with an average pass rate of 37.3% (DBE, 2014/15). The general trend of Mathematics results in South Africa shows that as

learners progress to higher grades their performance deteriorates (refer to table 1.1 below) and they “choose not to pursue Mathematics post-compulsory education” (Mutodi & Ngirande, 2014, p. 432). Here, statistics reveal that while in 2010, 48% of Grade 12 learners wrote Mathematics, the percentage reduced to 40% in 2015 (DBE, 2014/15; Spaull, 2016). The decline in the proportion of learners studying Mathematics post-compulsory grades results in a “critical shortage of people qualified in mathematics in South Africa” (Mutodi & Ngirande, 2014), especially among the majority Black South Africans. Table 1.1 below shows the average percentage marks obtained in Mathematics in the Annual National Assessment by grade from Grade 1 to Grade 9, and across the years 2011-2014 in South Africa. Learners were required to write a national assessment annually between 2011 and 2014, and the average percentages achieved are recorded in the table. The same examinations were written across the country, and Table 1.1 provides a comparison of the results of these.

Table 1.1 Average percentage marks in Mathematics by Grade (2011-2014) (Robertson & Graven, 2015, p. 13)

| <b>Grade</b> | <b>2011</b> | <b>2012</b> | <b>2013</b> | <b>2014</b> | <b>Grade averages across 2011-2014</b> |
|--------------|-------------|-------------|-------------|-------------|----------------------------------------|
| <b>1</b>     | 63          | 68          | 60          | 68          | 64,75                                  |
| <b>2</b>     | 55          | 57          | 59          | 62          | 58,25                                  |
| <b>3</b>     | 28          | 41          | 53          | 56          | 44,5                                   |
| <b>4</b>     | 28          | 37          | 37          | 37          | 34,75                                  |
| <b>5</b>     | 28          | 30          | 33          | 37          | 32                                     |
| <b>6</b>     | 30          | 27          | 39          | 43          | 34,75                                  |
| <b>9</b>     | n/a         | 13          | 14          | 11          | 12,6 (2012-2014)                       |

Research on mathematics learning and teaching has acknowledged identity as an important element that cannot be separated from learning (Boaler & Greeno, 2000; Martin, 2000; Martin, 2009; Nasir, 2002; Stinson, 2006; Anderson, 2007). Observation of the downward trend in the performance of learners as they progressed through the school system from primary to high school sparked my interest in the learners’ mathematical identities. The results depicted above (Table 1.1) suggest that learners who do not have a solid foundation in mathematics struggle as they move up the schooling system (DBE, 2015; Westaway, 2017).

Learners’ seemingly pervasive underperformance in South Africa is closely linked to their socio-economic status. In their analysis of national and international mathematics benchmarking tests, Spaull and Kotze (2015) report that learners in Grades 3 to 6 from quintile

1-3 schools (the poorest ones) are on average three years behind learners in quintile 5 schools (the wealthiest).

The quintile system was established in South Africa to address the issue of socioeconomic status and disparity in access to education. The DBE categorised the country's public schools into five quintiles for the purpose of allocating financial resources (Dass & Rinquist, 2017; Graven, 2014). According to Ogbonnaya and Awuah (2019), the categorisation is based on the socioeconomic status of a school and is determined by factors such as annual average income, unemployment rates, and general literacy level in the school's geographical location. The schools in the most economically disadvantaged (poorest) geographical areas are categorised as Quintile 1 schools (Hall & Giese, 2008). Schools in Quintiles 1 to 3 are non-fee-paying schools and receive more funding per learner from the government than schools in Quintiles 4 and 5, because the latter are in more economically advantaged geographical areas (Hall & Giese, 2008). These are fee-paying schools, because parents can afford to pay fees and require less governmental support than schools in lower quintiles (Ogbonnaya & Awuah, 2019).

In short, learners in schools situated in more affluent, predominantly urban and formerly 'whites only' neighbourhoods are outperforming those in poor and underprivileged townships and rural neighbourhoods (Westaway, 2017).

## **1.4 EDUCATION IN SOUTH AFRICA**

In this study, I focus on high school learners who share the experience of having participated in after school mathematics clubs as primary school learners. For this reason, I will briefly describe the South African primary school system. It consists of private and public schools which are governed by the DBE [DBE]. The DBE decentralises its functions through the nine provincial education departments, which are responsible for implementing national policies and dealing with local issues. South African school grades are organised into two broad bands, the General Education and Training [SP] and the Further Education and Training [FET] bands. The General Education and Training band consists of three phases: Foundation Phase [FP], Grades R-3; Intermediate Phase [IP], Grades 4-6; and Senior Phase [SP], Grades 7-9. The FET band consists of Grades 10-12. Completion of grades 1 to 9 is compulsory for South African learners.

The FP includes a reception year known as Grade R. While the policy intends all schools to offer Grade R, not all primary schools do. The FP offers three basic learning programmes – literacy, numeracy and life skills – intended to provide for the holistic development of the



learner (DBE, 2003). In the FP teachers are trained to teach all three learning programmes. The focus of the phase is on equipping learners with primary skills, knowledge and values, thereby laying a foundation for development (Samuelsson & Kaga, 2008). The FP falls in the category of Early Childhood Development [ECD], which – in keeping with international standards – caters for children from 0 to 9 years old (UNESCO Institute for Statistics, 2005). The DBE describes ECD as “an umbrella term that applies to the processes by which children from birth to about nine years grow and thrive, physically, mentally, emotionally, spiritually, morally and socially” (Department of Education, 2001, p. 3).

The formative years are considered a sensitive period for children’s survival, growth and development, and failure to facilitate this development can affect their later participation in society (Shonkoff & Phillips, 2000; Bierkster & Dawes, 2008). The DBE (2015) notes that “education experts agree that if a child does not learn the basics in Grades 1 to 3, that child will have difficulties in all the later grades.” All the participants in this study went through Grades 1 to 3 of the FP.

The IP offers six subjects: Life Skills, Social Sciences, Natural Sciences and Technology, Mathematics and two languages – one at Home Language level and one at First Additional Language level. This phase covers Grades 4 to 6 and teachers are required in their training to specialise in teaching one language together with at least two other subjects from among these (Department of Higher Education and Training [DHET, 2011]. In South Africa, most primary schools include Grades R – 7, although there are some combined schools which span Grades R – 12 (Pausigere, 2014). The IP is followed by the Senior Phase which covers Grades 7 through to 9. The FET Phase is the final phase of schooling, consisting of Grades 10-12. On successful completion of Grade 12 the learner achieves their National Senior Certificate and may then choose to pursue tertiary education.

Both international and local researchers argue that learners’ home languages should be used for the initial learning of mathematics (Setati & Planas, 2012; Taylor, Draper, Muller, & Sithole, 2013). South Africa has adopted this policy (DHET, 2011; DBE, 2010): the South African Language in Education Policy advocates “the use of home language as the language of teaching and learning especially in the early years of learning, while providing access to additional language(s)” (DBE, 2010, p. 6). Implementation of the policy is, however, uneven (Setati & Planas, 2012), as many learners learn in English in their early years of schooling, despite the limitations this imposes on epistemological access (DBE, 2010; Setati, 2005). None

of the participants in this study are home-language English speakers. Some learned in English from the beginning of primary school, while others transitioned to learning in English in Grade 4.

The final grade of the Senior Phase, Grade 7, is the final year that learners spend in primary school. From Grade 8 onwards they attend high school. Apart from taking a Home Language, a First Additional Language and Mathematics, SP learners do the following subjects: Economics Management and Science; Life Orientation; Natural Science; Creative Arts; Social Science; and Technology (DBE, 2021). The final three years of school are the FET Phase. At this point all learners study a Home Language, an Additional Language and Life Orientation. Learners are given the option to do either Mathematics or Mathematical Literacy, and they are required to choose a minimum of an additional 3 subjects from the 35 additional subjects offered (DBE, 2021). Learners must do either Mathematics or Mathematical Literacy, they cannot choose to do neither. In exceptional circumstances where learners “experience severe and intrinsic barriers in Mathematics; and or experience an intrinsic barrier to learning which manifests as dysphasia...and/or learning disorders such as dyslexia (Independent Examination Board, 2014). Extensive evidence needs to be provided for this exemption to be applied.

Mathematics, in the South African Curriculum and Assessment Policy Statement (DBE, 2011b, p. 8), is defined as:

...a language that makes use of symbols and notations for describing numerical, geometric and graphical relationships. It is a human activity that involves observing, representing and investigating patterns and qualitative relationships in physical and social phenomena and between mathematical objects themselves. It helps to develop mental processes that enhance logical and critical thinking, accuracy and problem solving that will contribute in decision-making. Mathematical problem solving enables us to understand the world (physical, social and economic) around us, and, most of all, to teach us to think creatively.

The DBE writes of Mathematical Literacy as (DBE, 2011c, p. 8):

The subject Mathematical Literacy should enable the learner to become a self-managing person, a contributing worker and a participating citizen in a developing democracy. The teaching and learning of Mathematical Literacy should thus provide opportunities to analyse problems and devise ways to work mathematically in solving such problems. Opportunities to engage mathematically in this way will also assist learners to become astute consumers of the mathematics reflected in the media.

## **1.5 PROBLEM STATEMENT**

South African primary mathematics education is described as being in a state of crisis, and various programmes are being implemented to develop intervention models to improve quality and ensure the effective teaching and learning of primary mathematics. The South African

Numeracy Chair Project (SANCP) initiative provides for longitudinal research and development programmes with primary mathematics teachers and learners from so-called previously disadvantaged schools, in order to find ways of mitigating the crisis. The SANCP after school South African primary mathematics education is described as being in a state of crisis, and various programmes are being implemented to develop intervention models to improve quality and ensure the effective teaching and learning of primary mathematics. The SANCP initiative provides for longitudinal research and development programmes with primary mathematics teachers and learners from so-called previously disadvantaged schools, in order to find ways of mitigating the crisis. The SANCP after school mathematics clubs provide extra-curricular activities focused on developing a supportive learning community where learners' active mathematical participation, engagement, enjoyment and sense making are the focus. The clubs provide a supportive learning environment in which learners can participate actively and freely in mathematical activities (Graven, 2011; Stott & Graven, 2013). Research shows that such out-of-school programmes rely on the active engagement and collaboration of learners to help repair marginalised learners' learning identities and trajectories (e.g., Wright, Martland, & Stafford, 2006; Graven, Hewana, & Stott, 2013; Walshaw, 2013; Oppland-Cordell & Martin, 2015). The expectation of active participation in a 'safe' environment in such after school programmes affirms learner agency and the development of confidence in their mathematical ability. Out-of-school programmes have the added advantage of being able to enrich learners' mathematical experiences because they are free from curriculum- and assessment-driven practices that often dominate in school classrooms (SANCP, 2013). The structure, ethos and pedagogical framework of after school mathematics clubs are discussed in detail in Chapter 2.

Through eliciting the mathematics identity stories of high school learners who have participated in primary school mathematics clubs, this study explores the nature of MLIs as learning trajectories that connect the past and future in negotiation of the present. It also seeks to discover how primary school club participation and experiences feature (if at all) in the learners' mathematical identities. The study draws on a range of socio-cultural theories of identity, especially Sfard and Prusak's (2005b) operationalised definition of identity as story.

## 1.6 RESEARCH QUESTIONS

The key research question addressed in this study is:

What are the MLIs of high school learners who participated in after school mathematics clubs in primary school?

The sub-questions include:

1. What are the key themes in learners' stories about their current mathematical participation?
2. How do learners' stories of their mathematics learning trajectories from their past participation to their imagined future participation feature in their present mathematics participation?
3. How does their participation in the after school clubs feature (if at all) in their mathematical identities?

## 1.7 TECHNICAL NOTES

The following technical notes pertain to the text in this thesis:

1. As per South African norms, 'learners' shall refer to school-going children from Grade R to Grade 12. 'Students' is used when referring to individuals attending tertiary education institutions, as well as when used in direct quotations.
2. The words 'Mathematics' and 'Mathematical Literacy' are capitalised when specifically used to indicate subjects and programmes, they are capitalised. Similarly, the word 'Grade' is capitalised when referring to a specific school grade level.
3. Learners' speech and writing is uncorrected in direct quotations.
4. In all references to learners, teachers and schools in the thesis, pseudonyms have been used.
5. The isiXhosa speech from the interviews was translated by Mr Brett Mulilo, and a forward and back translation was done by me to verify the accuracy.

## 1.8 OUTLINE OF CHAPTERS

**Chapter One** provides the background and rationale for my research, listing the research questions that the study seeks to answer. I describe the South African education system, and how it is burdened by the ongoing underperformance in mathematics of underprivileged learners.

**Chapter Two** provides a synopsis of the SANCP after school mathematics clubs and an analysis of the MLIs that they promote. It discusses the structure, aims and ethos of the clubs, explaining the benefits they can confer on learners who participate in them.

**Chapter Three** reviews relevant local and international research on after school mathematics clubs and their role in the construction of MLIs. Drawing on this literature, the study discusses aspects of primary MLI formation and how learner identities relate to curriculum practices. A working definition of MLI is then provided. The historical roots and development of identity theory are then discussed, with a particular focus on the importance of learner mathematical identities in mathematics education. The chapter also reviews literature that describes how mathematical identities evolve in after school mathematical programmes in other parts of the world and explains some of the theoretical and analytical frameworks that are used in exploring MLIs, before presenting the analytical framework used in the study.

**Chapter Four** describes the research design and methodology employed and justifies the research choices made. The study used a qualitative, interpretive approach to fashion a narrative case study research design. The sources of data in this study are questionnaires, interviews and participants' narratives. The chapter concludes with a discussion of key methodological issues pertaining to ethics and the validity and reliability of data.

**Chapter Five** presents the learners' mathematics stories, thick descriptions of each of the fourteen learners' mathematics trajectories, from when they started primary school to now. The narratives presented in this chapter provide an insight into what will emerge in the data analysis and discussion in Chapters Six and Seven. The chapter furnishes the necessary background for the main research question, which seeks to understand the MLIs of high school learners who participated in mathematics clubs in primary school.

**Chapters Six** discusses the findings emerging from analysis of the narrative data on the MLIs of Grades 9 and 10 learners. The chapters synthesise the findings to produce an understanding of the emerging learner identities of high school learners, and how these are intertwined with their participation in after school mathematics clubs.

**Chapter Seven** concludes the thesis, providing an overview of the study before highlighting the key findings of the research, its contribution and its limitations. Recommendations are made suggestions offered for further research in mathematics education focusing on learner identities.

## **1.9 SUMMARY**

In this chapter I explained the centrality of an MLI in the learning of the subject. Identity plays the role of a conceptual bridge between learning and its cultural setting. I described how MLIs evolve in response to learners' interactions in mathematics landscapes of practice and noted that some learners develop negative MLIs even though they actually perform well in the subject. The sad condition of mathematics education in South Africa was adumbrated by the presentation of statistical evidence of the poor performance of learners in both domestic and international assessments. The problem statement and the research questions of the study were formulated before an outline was provided of how the entire thesis is structured.

## **CHAPTER 2**

### **RESEARCH CONTEXT**

#### **2.1 INTRODUCTION**

In this chapter I provide an overview of the South Africa Numeracy Chair Project (SANCP) after school mathematics clubs and an analysis of the MLIs that they seek to promote. The documents I draw on in order to describe these clubs are journal publications about the design of the clubs as well as the clubs' own documentation on the SANCP website. I discuss the structure, aims and ethos of the clubs, and suggest the broad benefits of after school mathematics clubs for learners who participate in them. As indicated in Chapter 1 (1.3), the participants in this study were specifically chosen because of their experience of a maths club. The aim is to ascertain whether that experience features in their MLIs, and if so, how.

#### **2.2 SANCP AFTER SCHOOL MATHEMATICS CLUBS**

The numerous initiatives to monitor and measure the performance of learners in numeracy in South Africa continue to report poor performance in many primary schools (SAQMEQ, 2010; Fleisch, 2008; Taylor, Fleisch, & Schindler, 2008; Bloch, 2009). This situation, often described as a crisis, has prompted national research funding organisations to invest in research projects that focus on the specific issue of numeracy in several universities (Stott & Graven, 2013). The SANCP project at Rhodes University focuses on development and research in numeracy in some primary schools in the Eastern Cape Province. Among its broad aims are the improvement of learner performance in primary schools through quality teaching and learning and promoting research that looks toward finding sustainable solutions to the many numeracy education challenges faced in the province (Stott & Graven, 2013).

Graven (2011, p. 161) conceptualises the SANCP after school mathematics clubs as “extra-curricular clubs focused on developing a supportive learning community where learners’ active mathematical participation, engagement, enjoyment and sense making are the focus.”

According to the Mathematics Curriculum and Assessment Policy Statement [CAPS] (DBE, 2011a), the teaching and learning of the subject must encourage a learner-centred and activity-based approach. The policy document advocates the inculcation of considerable knowledge and skills, a task requiring the empowerment of those sectors of the population which were previously disempowered by a lack of knowledge and skills and the education system generally. The policy envisages the creation of a lifelong learner who is confident, independent

and able to “identify and solve problems and make decisions using critical and creative thinking” (DBE, 2011a, p. 11).

Although the South African Mathematics Curriculum foregrounds learner participation in the classroom, research studies show that teacher-led instructional methods remain the first choice (Umugiraneza, Bansilal, & North, 2017). This might be a result of the fact that content prescribed in the Mathematics Curriculum is explicitly delimited, paced, and sequenced with prescribed textbooks, workbooks and working examples. In this way teachers are “reduced to passing out worksheets and drilling children” (Ramatlapana & Makonye 2012, p. 23). The prescriptions restrict teachers’ professional autonomy and lead them to teach for assessment, sacrificing learners’ understanding and acquisition of functional knowledge and skills. With greater autonomy, teachers are theoretically enabled to think and act more freely in the best interest of the learners (Ozturk, 2011), and probably promote participative MLIs.

The SANCP after school mathematics clubs draw on this National Curriculum Statement but are not assessment-oriented in any way; they value engagement in and enjoyment of mathematics through playing mathematical games, puzzles and quizzes, as explained in the following section.

### **2.2.1 Aims of the SANCP After School Mathematics Clubs**

The SANCP after school mathematics clubs were established to promote different MLIs from those typically fashioned in classrooms where learners are passive recipients of knowledge. They were set up to confront and counter the situation in which mathematics learners in South Africa have little agency and are generally passive, and in which teaching is generally procedural, allowing learners little agency and requiring them to follow rules mechanically (see Ramatlapana & Makonye 2012; Umugiraneza, Bansilal & North, 2017). The protocols of this form of learning include rote and surface learning, collective chanting, chorus, copywriting and drill (Hoadley, 2018). In contrast, the primary aim of the SANCP after school mathematics clubs was to:

... provide learners a space where they could ask their own questions, produce their own mathematics, talk mathematics, explain mathematics, and enjoy mathematics! There would be no ‘on the board’ whole class teaching and learners needed to arrive with their mathematical productions and ideas about what they wanted to work on. (Graven, 2011, p. 166)

In this way, the clubs afford learners the opportunity to develop more participatory mathematical identities, given the opportunities provided for learner engagement, negotiation and participation (Wenger, 1998). The clubs also became a space for negotiating future possible



mathematical trajectories through discussing and investigating career options and the various educational requirements for them (Graven, 2011).

Table 2.1, below, summarises the contrasts between the learning environments typical of ordinary classrooms, on the one hand, and the learning environment afforded to learners in the SANCP after school mathematics clubs, on the other:

Table 2.1: Ordinary classroom and club environments contrasted

| <b>Ordinary Mathematics classroom environment†</b>                                                                                                                   | <b>Intended club environment</b>                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Compulsory attendance is expected as part of formal schooling (in-school time)                                                                                       | Voluntary participation during out-of-school time                                                                                              |
| Less learner choice in the activities that they work on and engage with                                                                                              | More learner choice in the activities that they work on and engage with                                                                        |
| Curriculum and assessment standards as a prescriptive framework strongly influencing choice of content and activities (i.e., the South African Curriculum documents) | Curriculum as contextual guide for what is nationally expected of learners but individual learner numeracy levels guide content and activities |
| Largely acquisition based and often driven by teaching for/to assessments                                                                                            | Participation based; participants are active and engaged                                                                                       |
| Teacher led and much whole class teacher–learner interaction                                                                                                         | Many interactions are learner led with few whole class–mentor interactions and many one-to-one interactions between mentors and learners       |
| Assessment tends to be summative and results in ranked performance (e.g. South African Annual National Assessments)                                                  | Assessment is formative and integrated and used to guide individual learning experiences for participants                                      |
| Prescriptive, teacher-controlled classroom rules within general school rules                                                                                         | Negotiated socio-mathematical norms‡ which may differ from in-school time rules                                                                |

Source: Adopted from Graven, M., & Stott, D. (2012). Design issues for mathematics clubs for early grade learners. In D. Nampota, & M. Kazima (Eds.), Proceedings of the 20th Annual Meeting of the Southern African Association for Research in Mathematics, Science and Technology Education (pp. 94–105). Lilongwe: SAARMSTE.

† It is important to note that items on the left-hand side are not considered negative but rather in line with school norms, whilst much more freedom is available in the clubs.

‡ Cobb and Yackel (1996); Hunter (2008).

While agreeing that ordinary Mathematics classrooms can provide opportunities for the development of participatory and positive learner identities, Graven (2011, p. 161) believes that the extra-curricular nature of after school mathematics clubs provides “increased freedom to focus on the deliberate construction of positive participatory mathematical identities intentionally at the expense of covering the range of skills and knowledge required to ‘get through’ the curriculum.” The SANCP after school clubs involve individual, paired and small group interactions with mentors and very few interactions with the whole club (Stott & Graven, 2013). This deliberate bias towards pairs and small group interaction, which promotes one-to-one interaction between club mentors and learners and among learners themselves, contrasts with the teacher-led pedagogical practices in the traditional classrooms in which participants in this study were also schooled from Grade 1 to the present.

## 2.2.2 Mathematical proficiency in the after school mathematics clubs

The SANCP after school clubs’ aims are aligned with the five strands of mathematical proficiency (Kilpatrick, Swafford, & Findell, 2001), as explained below:

*Conceptual understanding* – comprehension of mathematical concepts, operations and relations; *procedural fluency* – skill in carrying out procedures flexibly, accurately, efficiently and appropriately; *strategic competence* – ability to formulate, represent, and solve mathematical problems; *adaptive reasoning* – capacity for logical thought, reflection, explanation and justification, and *productive disposition* – habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one’s own efficacy. (p. 5)

The SANCP after school mathematics clubs promote the development of mathematical proficiency in all learners. They hold the potential to address some of the challenges that young numeracy learners face, such as a lack of confidence (Graven, 2011). In fact, “clubs are an opportunity for disrupting passive learning culture and deliberately working with learners to become confident mathematical participators” in their learning communities (Graven, 2011, p. 165). When club activities involve the deliberate creation of more engaging, confidence-building and participatory forms of practice and the disruption of passive teacher-dependent ‘ways of being,’ learners have an increased opportunity to re-author themselves (and be re-authored) as mathematical producers, mathematical questioners, and mathematical explorers (Graven 2011; Graven, 2015; Stott & Graven, 2013). Stott (2016) explains that the SANCP clubs have a theoretical grounding in the work of Vygotsky:

The relationship between social and individual learning and development in the Vygotskian perspective forms an important foundation for the design of the project club-learning programme as the clubs aim to encourage more participatory mathematical practices whilst

at the same time promoting the development of individual learner mathematical proficiency. (p. 251)

The clubs further provide the facilitators with the opportunity to author different MLIs from the ones that originate in the traditional classroom. The intended MLIs that are listed in the “Starting an after school maths club” booklet on the SANCP website include active and playful mathematical engagers, resilient problem solvers who embrace mistakes and take them as opportunities to learn, lovers of mathematics and confident mathematics learners who rise to challenges.

### **2.2.3 Ethos in SANCP after school mathematics clubs**

Stott (2014, p. 61) makes it clear that one “key aspect of the club environment is to develop an exploratory ethos” that encourages learners to explore and not worry about making mistakes, but rather to learn from these mistakes. after school mathematics spaces promote purposeful interpersonal activities that are grounded in interactions between learners in the spirit of encouraging participatory learner identities (Askew, Brown, Rhodes, Johnson, & William, 1997). Learners are exposed to socio-mathematical norms, for example normative aspects of club mathematics discussions specific to learners’ mathematical activities in the clubs (Yackel & Cobb, 1996). These socio-mathematical norms evolve from mathematical activity between all classroom or club participants and are “negotiated in the discursive dialogue” (Hunter, 2008, p. 31). Further, this negotiation of shared meaning can involve lengthy sequences of encounters and transactions among learners and the teacher in the classroom (Mottier-Lopez & Allal, 2007). In the SANCP after school mathematics clubs, learners are encouraged to bring “their mathematical productions and ideas about what they wanted to work on,” in the spirit of fostering greater agency among them (Graven, 2011, p. 166).

Discussion at the SANCP after school mathematics clubs revolves around the nature of mathematics, and how learners can tackle various concepts in a manner that does not alienate them from the subject but rather promotes enjoyment and understanding of it. This coheres with Barwell’s (2005) argument against the tendency amongst policy makers and maths educators to stress the distinction between the precise subject language of mathematics and more informal talk. Barwell (2005) maintains that this can hinder the process of inducting learners into mathematical practices. Rather, the practice of working in small groups that is embedded in the after school mathematics club ethos promotes informal mathematics talk. While emphasising the value of the teacher’s guiding role, Mercer and Sams (2006) maintain

that small-group activities offer valuable opportunities for learners to construct solutions for themselves through talk, which would not be found in whole-class instruction.

Earlier research indicates that learners become numerate through “purposeful interpersonal activity based on interactions with others” (Askew et al., 1997, p. 35), and that numeracy teaching is based on “dialogue between teacher and pupils to explore understandings” (p. 36). This connectionist orientation gives the SANCP after school mathematics club mentors practical guidelines for ways of promoting numeracy in the clubs and for explaining their beliefs about what numeracy is and how learners become numerate (Stott, 2014). The connectionist orientation foregrounds the belief that:

teaching mathematics is based on dialogue between teacher and pupils, so that teachers better understand the pupils’ thinking and pupils can gain access to the teacher’s mathematical knowledge. This belief manifested itself in practice through extensive use of focused discussion to help pupils explore efficient strategies and interpret the meaning of mathematical problems. (Askew et al., 1997, p. 32)

The SANCP after school mathematics clubs foregrounded socio-mathematical norms, the normative aspects of classroom activity relating specifically to mathematics, such as the ways in which decisions are made regarding the quality of a mathematical argument (Yackel & Cobb, 1996). They relied on games for promoting fluency in mathematics talk (Graven & Stott, 2016). This helped to boost learners’ general communication skills, a vital element in the Vygotskian perspective on learning.

## **2.3 BENEFITS OF AFTER SCHOOL MATHEMATICS CLUBS**

Out-of-school activities like mathematics clubs are not unique to South Africa, nor to the Eastern Cape Province. They are common in other developed countries such as the United States of America, the United Kingdom, several European countries and the Australasia region, to mention just a few. Generally, they serve learners and youth of all ages and encompass a wide range of focus areas, including academic support, mentoring, youth development, arts, sports and recreation (Fashola, 2003; McDaniel & Yarborough, 2016). While after school programmes in the US receive Federal funding (After School Alliance, 2015) in South Africa the programmes are new, wholly funded by independent sources, and thus not compulsory. The participants in this study took part in the activities of voluntary after school mathematics clubs, where they were encouraged to assume mathematical identities that are different from the mathematics associated with the traditional classrooms that they passed through while they were in primary school.

Several studies have reported a positive impact from after school mathematics clubs on mathematics achievement, covering academic, personal and social aspects of the learners' lives (Lauer, et al., 2006; Crawford, 2011; Brown, 2017). The findings are consistent with the consensus that successful youth programmes are interactive in nature, use coaching and role playing, and employ structured activities to guide youths towards the achievement of specific goals (Tobler, et al., 2000; DuBois, Holloway, Valentine, & Cooper, 2002). I discuss some of the general benefits of after school mathematics clubs in the next section.

### **2.3.1 Academic and social development of participants**

Generally, after school mathematics clubs cultivate supportive relationships between staff and youth participants. They also provide rich and varied academic activities and additional enrichment opportunities, while fostering strong connections within schools and with local community organisations (Vandell, Reisner, & Pierce, 2007; Beesley, Fancsali, & Gaulemetova, 2018). Although reviews of after school programmes vary in their conclusions regarding academic development, most show that on average these programmes have a positive impact in terms of academic, social and emotional outcomes (Baker, Rieg, & Ckendaniel, 2006; Vandell et al., 2007; Granger, 2008). A positive impact has also been documented locally in respect of the SANCP after school mathematics clubs (see Graven, 2011).

According to Baker, Reig and Ckendaniel (2006), the benefits of after school tutoring programmes include increased learner achievement, a higher self-esteem, more and free participation in class, and an increase in the completion of homework assignments. Other studies report upward trends in mathematics test scores for programme participants when compared to those of learners who did not participate (Fletcher & Padover, 2003; Frosch & Sprung, 2011). This improvement may be credited to the learners' use of mathematical concepts learned in the various mathematics clubs' activities they participated in, as well as in their mathematics classrooms. The clubs enhance learners' self-esteem (Baker et al., 2006) which is a critical element in learners' mathematical identities. Papanastasiou and Bottiger, (2004) agree that after school mathematics clubs provide opportunities for learners to develop personal self-esteem, inquiring minds, relatively close human relationships, and a sense of belonging, purpose and usefulness. Importantly, the skills and knowledge gained through engagement in after school mathematics programmes are not exclusive to science, technology, engineering and mathematics (STEM), since outcomes such as increased communication skills and the ability to work in groups are essential in any career (Sahin, Ayar, & Adiduzel, 2014).

There is also an indication that after school activities can have positive effects on the achievement of low-achieving or at-risk learners in reading and mathematics (Lauer, Akiba, Wilkerson, & Martin-Glenn, 2004). Structured after school mathematics programmes can therefore facilitate the acquisition of academic skills and social skills among middle-school learners (Posner & Vandell, 1994). Out-of-school mathematics clubs in any event supplement learning from the school day and provide targeted assistance to learners with educational needs that are not being adequately addressed in the classroom (Beckett, et al., 2009; Brown, 2017).

### **2.3.2 Participative skills**

The literature about after school mathematics clubs insists that effective teaching strategies for young learners involves active forms of learning that require learners to act on the material or content they are learning about (Durlak, Weissberg, Dymnicki, & Schellinger, 2011). Salas and Cannon-Bowers (2001, p. 480) concur that it “is well documented that practice is a necessary condition for skill acquisition.” The SANCP after school clubs address the needs of the learners being served and the activities in their programme reflect more extensive learning than the regular school content. They include project-based learning activities that may or may not be aligned with the school content, and the intentional inclusion of non-academic activities for social skills improvement (Noam, Biancarosa, & Dechausay, 2002). In short, after school mathematics clubs value activities that promote social interaction and problem solving through active participation.

### **2.3.3 Developing and fostering problem-solving skills in after school clubs**

Problem-solving skills are developed and fostered in learners in after school clubs. Defining problem solving appears to be problematic as several distinct definitions exist. Krulik and Rudnick (1980) define problem solving as the means by which an individual uses previously acquired knowledge, skills, and understanding to satisfy the demands of an unfamiliar situation. Closely linked to this definition is the Organisation for Economic and Cooperation and Development [OECD] (2003) view that problem solving relates to learners’ capacity to use cognitive processes to confront and resolve real, cross-disciplinary situations where the solution path is not immediately obvious and where the literacy domains or curricula areas that might be applicable are not within a single domain of mathematics, science or reading. Both definitions show that learners must synthesise what they have previously learned from different subject areas and apply it to new and different situations. Therefore, mathematical reasoning

and problem solving require teachers to teach mathematics as the power of thought rather than the power of discrete facts (Sutton & Krueger, 2002).

The literature on the SANCP mathematics clubs show that activities performed in the clubs are pertinent to the social, emotional and physical development of learners. Globally, the activities in out-of-school networks support the development of collaboration, discussion and teamwork that are conducive to deeper levels of understanding in mathematics (Briggs-Hale, Judd, Martindill, & Parsley, 2006). As low-stress environments, clubs facilitate teamwork, cooperation and mutual support (Fry, Ketteridge, & Marshall, 2009).

Instructional methods in after school clubs spur independent cognition in learners and develop their capacity to listen carefully when attempting to solve given problems. Problem-solving skills acquired in this way assist learners to use what they know about mathematics facts, skills, and strategies to solve local problems (Briggs-Hale et al., 2006). Although some researchers in mathematics instruction have claimed that problem solving is not the only way to learn mathematics (Van-de-Walle, 1994; National Council for Teachers of Mathematics [NCTM], 2000), it remains a critical component and any activities that aid in its development need to be zealously pursued.

Games that are played in after school mathematics clubs are well known for developing problem solving skills. McClarty et al. (2012, p. 9) argue that “we think and understand best when we can imagine a situation and that prepares us for action.” Games stimulate the imagination through simulation, providing learners with the opportunity to think, understand, prepare, and execute actions (Gee, 2003). Advocates of game-based learning in education cite the ability of digital games to teach and reinforce skills that are important for future jobs such as collaboration, problem-solving and communication (McClarty et al., 2012). It is apparent that problem solving is a skill that remains relevant throughout one’s life. The SANCP after school mathematics club website (<https://www.ru.ac.za/sanc/resources/>) features a whole range of mathematical games that the participants in my study played during their time in the clubs.

#### **2.3.4 The power of problem-solving skills**

Learners endowed with problem-solving skills have the capacity to think beyond the ordinary. Their problem-solving skills push them to determine the difficulty or ease with which obstacles to solutions can be overcome (PISA 2012 Field Trial Problem Solving Framework, 2010). When learners are given the opportunity to explore their preconceptions and engage their own problem-solving strategies, they are able to build new knowledge (National Research Council

of the National Academies [NCR], 2005). Moreover, in the problem-solving context learners are offered rigorous opportunities to develop the skills to communicate reasoning and strategies (NCTM, 2000; NCR, 2005; Van De Walle, 1994). The literature suggests that the intentional integration of problem solving in after school activities supports conceptual knowledge in mathematics and more generally, by encouraging discussion, interaction, and collaboration (Briggs-Hale et al. 2006).

## **2.4 SUMMARY**

In this chapter I have described the ethos of SANCP-run after school mathematics clubs and the mathematical identities that they privilege. The link between Vygotskian principles of learning and development and the learning methodology in the after school clubs was explained. The MLIs promoted by the SANCP clubs aim to reverse the passive mathematics learning identities that SANCP researchers had noted in initial classroom visits and from their learner dispositional research (Graven, 2011).

The clubs provide the facilitators with an opportunity to “story” different MLIs from the ones that are storied in the traditional classroom. The intended MLIs listed in the “Starting an after school maths club” booklet on the SANCP website include active and playful mathematical engagers, resilient problem solvers who embrace mistakes and take them as opportunities to learn, lovers of mathematics and confident mathematics learners who rise to challenges. The pedagogies in the after school mathematics clubs are deliberately learner centred and highly participative. The chapter concluded by explaining the broader benefits to learners of after school mathematics clubs.



## **CHAPTER 3**

### **THEORETICAL FRAMING AND LITERATURE REVIEW**

#### **3.1 INTRODUCTION**

The purpose of this chapter is to situate the study by discussing the historical roots and development of identity theory, and to explain the theoretical and analytical frameworks that I used to explore learners' MLIs. I define the terms identity and mathematical identity and demonstrate the importance of learner mathematical identities in mathematics education. The chapter reviews literature that describes how mathematical identities evolve in after school mathematical programmes, both locally and in other parts of the world. I also discuss myths surrounding the learning and teaching of mathematics and the importance of MLI in dispelling them.

#### **3.2 HISTORICAL ROOTS OF IDENTITY THEORY**

Although the term identity is not new in the research field, it is only recently that it has begun to draw the attention of educators at large, and of researchers in mathematics education in particular (see, e.g., Boaler & Greeno, 2000; Cobb, 2004; Roth, 2004). The modern conception of identity in the social sciences can be traced back to the work of Mead (1934) and Erikson, (1968), who offered two distinct definitions of the phenomenon.

An Eriksonian “identity” is overarching. It weaves together an individual’s answers to questions about who he or she is as a member of the cultural and social group(s) that make up his or her society. A Meadian identity, on the other hand, is a sense of oneself as a participant in the social roles and positions defined by a specific, historically constituted set of social activities. Meadian identities are understood to be multiple [...] and they may reflect, for example, contradictory moral stances. Eriksonian approaches, in contrast, attribute psychodynamic significance to achieving a coherent and consistent identity that continues over the course of adulthood. (Holland & Lachicotte, 2007, p. 104)

Graven and Lerman (2014) explain that for Erikson, identity was a more unified concept, developing uniquely throughout one’s life, while Mead maintains that identities are in flux. Darragh (2016) distinguishes between these perspectives by noting that “Erikson understood identity as an acquisition, something that one has and that becomes coherent and consistent [while a] Meadian identity is an action, it is something one does, and it is multiple, contradictory and socially constituted” (p. 27).

Identity theory as applied in much of the research in mathematics education is rooted in the work of Mead (Darragh, 2016). Mead (1967, in vom-Orde, 2016) explains that individuals form their identity through processes of interaction and communication, and conflicts and

anomalies in modern societies have direct effects on a person's identity formation. It follows that learners' lives are a reflection of the society in which they live and that their behaviour and conduct are informed by their experiences of the world. Change or flux in learners' identities can therefore be attributed to the dynamism of culture. The sociological perspective on Mead's framework of identity is summed up by Stryker and Burke (2000, p. 285) as follows:

Society is seen as a mosaic of relatively durable patterned interactions and relationships, differentiated yet organised, embedded in an array of groups, organisations, communities, and institutions and intersected by crosscutting boundaries of class, ethnicity, age, gender, religion and other variables.

Many influential works on identity in education (see Holland, Skinner, & Cain, 1998; Wenger, 1998; Gee, 2000; Sfard & Prusak, 2005a, 2005b) are aligned to the Meadian school of thought, whose pivotal assertion is that self reflects society (Stryker & Burke, 2000). The self or identity is seen as multifaceted and composed "of interdependent and independent, mutually reinforcing and conflicting parts" (p. 286). Gee (2009) explains that people have multiple identities that are not connected to their internal states, but to their performances in society. Therefore, individuals have various identities that reflect their practices and ways of participating in the various groups of people that they interact with in society.

A notable challenge for theories from 'the social turn' is to account for individual cognition and difference, and to incorporate the substantial body of research on mathematical cognition, as products of social activity (Lerman, 2000). While the notion of identity has had a long history in other disciplines in the social sciences such as psychology and sociology, in mathematics education research its appearance seems to be connected to the adoption of socio-cultural theories to explore mathematical learning, in particular the idea of learning as a process of becoming a participant in a learning community (Wenger, 1998).

### **3.3 DEFINING IDENTITY**

The concept of identity in the academic world is not clear-cut but slippery and sometimes vague. Darragh (2016) describes it as 'nebulous' and notoriously dependent on context and ideology. Although, as a notion, identity is a perfect candidate for the role of 'the missing link' in researchers' stories of the complex dialectic between learning and its sociocultural context, it cannot become useful unless it is provided with an operational definition (Sfard & Prusak, 2005). Individual researchers have had to align their work with one definition or another for it to make sense. Accordingly, Darragh and Radovic (2019) understand identity as a socially produced way of being or of becoming enacted and recognised in a given context. In this sense, identity is a form of argument people use to justify, explain and make sense of themselves

(MacLure 1993), and it is constructed in and through social discourses. This perspective is usefully balanced by Mendick's (2005) view that identities reflect the continuous struggle of individuals to negotiate a personal story within wider or dominant discourses.

While subjects also construct identities collectively and in response to societal restructuring, uncertainty plays a significant role, turning identity into a shifting, unfixed, and unending entity as it involves the reconstruction of meaning over space and time (Norén, 2011; Chronaki & Matos, 2014). The concept of identity is succinctly summarised by Kaasila, Hannula, Laine and Pehkonen (2006, p. 1) as the “who-we-are that develops in our minds and in the minds of others as we interact.” Identity is thus the sense of self that a person has (Stentoft & Valero, 2009), evolving in response to interaction in society. In the present context, we might say that learners acquire different identities as a result of interactions in different landscapes of practice.

According to Darragh (2016), researchers in the identity field broadly define identity in one of five different ways: participative, narrative, discursive, psychoanalytic and performative. I summarise the definitions in Table 3.1, below:

Table 3.1 Identity definitions

| <b>Identity defined</b> | <b>Definition</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Participative           | Participative identity refers to identity definitions which look at the ways in which identity is constructed through participation and engagement in a social group (Darragh, 2016, p. 24). For example, Wenger (1998 p 151) defines the concept of identity as “a layering of events of participation and reification by which our experience and its social interpretation inform each other.” More specific to the present context, “identity refers to the dispositions and deeply held beliefs that individuals develop about their ability to participate and perform effectively in mathematical contexts and to use mathematics to change the conditions of their lives” (Martin, 2012, p.57-58). |
| Narrative               | Denzin (1989, p. 37) states that, “a narrative is a story that tells a sequence of events that are significant for the narrator and his or her audience.” For example, Sfard and Prusak (2005b, p. 16) define narrative identity as “the set of stories people tell about themselves and others tell about them, specifically narratives that are reifying, endorsable and significant.” In the                                                                                                                                                                                                                                                                                                            |

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | same vein Gweshe and Brodie (2019, p. 255) define “mathematical identity as stories about a person’s confidence, beliefs and persistence with mathematics.” Lastly, Kaasila (2007b) explains that narrative identity is a context-bound concept such that one can have many narrative identities, each of which is connected to different contexts or social relationships.                                                                                                                                                                                                                                                                                                                                     |
| Discursive     | Foucault (1972), a post-structuralist, refers to discourses as systems of thought composed of ideas, attitudes, courses of actions, beliefs and practices that systematically construct the subjects and the worlds of which they speak. Bishop (2012, p. 44) defines discursive identity as “the spoken and written words, semiotic systems, representations, and gestures of participants as they use language to communicate, interact, and act” (e.g. Mendick, 2005; Walshaw, 2013; Chronaki & Matos 2014). In other words, identities are a continuous struggle, or <i>identity work</i> , in which individuals need to negotiate a <i>personal</i> story within wider/dominant discourses (Mendick 2005). |
| Performative   | “The stylised repetition of acts over time that works to constitute one’s identity” (Darragh 2016, p. 26).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Psychoanalytic | According to Vanheule and Verhaeghe (2009), identity is the “term used to reflect self-understanding and experiences of collective belonging...” (p. 391).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

The broad concept of identity refers to how a person understands his or her relationship to the world, how that relationship is constructed across time and space, and how the person understands possibilities for the future (Norton, 2000; Lee & Anderson, 2009). According to Wenger (1998, p. 153), “we know who we are by what is familiar, understandable, usable, negotiable; we know who we are not by what is foreign, opaque, unwieldy, unproductive.” Solomon (2007) explains that the sociocultural perspective in education characterises identity as learners’ experiences of a common enterprise, with shared values, assumptions, purpose and rules of engagement and communication. The concept of identity is therefore thought of as man-made and as constantly created and re-created in interactions with others (Holland & Lave, 2001). The identities of learners relate to the diversity of context they find themselves in. Lastly, identity talks to the totality of one’s self-construal, in which how one construes

oneself in the present expresses the continuity between how one construes oneself as one was in the past and how one construes oneself as one aspires to be in the future (Weinreich, 1986). The foregoing definitions thus suggest that identities are foregrounded in how an individual perceives himself or herself in relation to certain phenomena and how that perception affects his or her participation in the landscapes of social practice.

### **3.4 CONCEPTUALISATION AND OPERATIONALISATION OF MATHEMATICAL IDENTITY**

Researchers have come up with various definitions of the concept of mathematical identity. Darragh and Radovic (2018, p. 1) define mathematical identity as “a socially produced way of being, as enacted and recognised in relation to learning mathematics.” The social aspect relates to the relationships and interactive moments between learners, their peers and their teachers (Heyd- Metzuyanim and Sfard, 2012). This means that mathematics identity is not something that belongs to an individual in isolation, but it is inherently bound to social contexts; identity depends on the physical, temporal, and interpersonal context, and correspondingly it is a fluid and constantly changing process (Darragh & Radovic, 2018). According to Cobb, Gresalfi and Hodge (2009) the concept refers to the ways that learners think about themselves in relation to mathematics and the extent to which they have developed a commitment to, and have come to see value in, mathematics.

According to Van-Zoest and Bohl (2005) mathematical identities are unique to the individual as they embody the knowledge, beliefs, commitment and intentions of that individual in the learning of mathematics. Another perspective on mathematical identity perceives it as:

the participants’ beliefs about (a) their ability to perform in mathematical contexts, (b) the instrumental importance of mathematical knowledge, (c) constraints and opportunities in mathematical contexts, and (d) the resulting motivations and strategies used to obtain mathematics knowledge. (Martin, 2012, p. 19)

In other words, mathematical identity changes as learners traverse different landscapes of practice. Following this, mathematics identities are produced and reproduced in ways that can be understood by zooming in and zooming out from individuals to the social realities that surround them (Lerman, 2001). Radovic et al. (2018) bring some order to this definitional diversity by conceptualising MLI in three main dimensions and five categories, which are explained below.

### **3.5 IDENTITY DIMENSIONS IN MATHEMATICS EDUCATION RESEARCH**

In a recent analysis of 69 research papers from various parts of the world, Radovic et al. (2018) revealed three main dimensions that characterise how identity is conceptually defined in mathematical learner identity research literature: social/subjective, enacted/representational and change/stability. They also identified five categories that describe how the literature has implemented these dimensions operationally, as (1) identity as individual attributes; (2) identities as afforded and constrained by local practices; (3) identity as a relationship with specific practices; (4) identity as ways of acting; and (5) identity as narratives.

#### **3.5.1 Social/subjective identity dimensions**

Radovic et al.'s (2018) systematic review of mathematics learner identity (MLI) establishes that:

a subjective notion of oneself was considered when authors mentioned in their conceptualisation of identity subjects' senses or experiences, such as sense of continuity, sense of a place in the world, a sense of being, a sense of connection or belonging, a self-view, or even as self-descriptions. (p. 6)

They explain that the use of the word “sense” positions learner identity as a private experience of who the learner is. But still under the purview of the social/subjective dimension, Radovic et al. (2018) document that many studies on MLI draw from the Meadian school of thought to conceptualise identity by emphasising its social aspect. Some studies regard identity as a social product, something constituted by social discourses, a space in which discourses work and are worked (see Solomon, 2012; Andersen & Ward, 2013). To support the view that identity is malleable, fluid and socially constructed, Nasir & Hand (2008, p. 147) state that, “we as people don't remake ourselves in every social interaction, but just as clearly we don't achieve identity for once and for all at any one point in time – we renegotiate it across the lifespan and in the multiple contexts of our lives.” It is clear that if mathematical identities are negotiated and renegotiated in the various environments in which learners participate, their identities have spatial and temporal dimensions and are always in flux.

#### **3.5.2 Enacted/representational identity dimensions**

Radovic et al. (2018) note that the representational notion of identity assumes that it is necessarily mediated by discourse or language. This can be contrasted with the view of MLI as expressed or performed in action, with no necessary mediation of language or representation. The expressive and performative dimension is often considered in studies that illuminate the idea of engagement in action, employing concepts such as ways of being in action, forms of

participation, forms of engagement, or roles performed during activities (see Bishop, 2012; Solomon, 2012; Darragh, 2013). Identity thus becomes something that you do (Gutiérrez, 2013). Darragh (2013, p. 225) argues that:

If teachers and learners judge someone as competent at mathematics because they perform confidently in class, then perhaps when learners demonstrate to themselves the confidence to answer questions in class, they could judge themselves as competent, thus developing a more positive identity as a learner of mathematics. This can be seen as a performative notion of identity construction.

These different conceptions are used to reveal “how different ways of being in action may constitute different identities” (Radovic et al., 2018, p. 6).

### **3.5.3 Change/stability identity dimension**

The last dimension, the change/stability dimension, relates to how the process of change is described in the conceptualisation of MLI (Radovic et al., 2018). Most studies recognise that identity is constructed through a process, an ongoing process of learning, and therefore always open to change. Radovic et al. (2018) insist on the temporary nature of MLI, while other studies explicitly define identities as fluid, in process, malleable and dynamic (Holland et al., 1998; Nasir & Hand, 2008).

## **3.6 CONCEPTUAL AND METHODOLOGICAL EMPHASES IN APPROACHES TO IDENTITY**

Radovic et al. (2018) identify five categories that describe how these three dimensions have been applied or operationalised: identity as individual attributes, identity as a relationship with specific practices, identity as ways of acting, identity as afforded and constrained by local practices, and identity as narrative. I shall now explain these categories and identify the one used in my research.

### **3.6.1 Identity as comprising individual attributes**

The definition of identity under the rubric of individual attributes emphasises the subjective end of the subjective/social dimension, evoking a notion of self as consisting of individual attributes (Radovic et al., 2018). These attributes have a representational nature in that they are always discursively mediated and are predominantly investigated via self-reports (Radovic et al., 2018). In terms of this category, although the social world seemingly influences the construction of MLIs, individuals are considered as separate from the social context (as in Erikson’s perspective). Thus, identities are construed “as “self-views,” “self-descriptions,” “self-concepts,” “self-competence,” or “self-esteem” (Radovic et al., 2018, p. 7). The attributes

associated with identity are seen as individually bound and relatively independent from the discourse (of, say, mathematics) (Lesko & Corpus, 2006; Andersen & Ward, 2014).

Definitions of identity in this category do not place much emphasis on the relationship between individuals' identities (subjective) and a particular situated mathematical activity (social) extent. Individuals and their social contexts are conceived as separate entities, with social factors influencing learners' personal variables (i.e. identity attributes). In the studies by Pronin, Steele and Ross (2004) and Lesko and Corpus (2006), the process of identity construction is explained as the individual's response to a social stereotype by identity bifurcation (i.e. separating oneself from the stereotyped activity) or identity correspondence (i.e. seeing the individual identity as compatible with the stereotyped activity).

### **3.6.2 Identity as a relationship with a specific practice**

Identity as a relationship with a specific practice emphasises how identities are defined by the relationship that learners establish with a particular (social, mathematical) practice, a relationship that is described mainly as subjective and representational (Radovic et al., 2018). In this category, researchers use self-report tools like interviews, narratives, and surveys for data collection. Subjective and social features are unified in individuals' identities (Radovic et al., 2018). Consequently, the relationship of the learner with the particular practice becomes the object of focus. "Although some ... studies used a narrative approach, these were not seen as the essence of identity, but simply a means to investigate the relationship of individuals with a practice" (Radovic et al., 2018, p. 10).

### **3.6.3 Identities as ways of acting**

With this category, the focus shifts from the representational to the enacted aspects of MLIs. This perspective belongs to participationist theories that view learning as becoming a participant in a community (Lave & Wenger, 1991). Participation is "a constantly changing process where identities are negotiated in moment-by-moment interactions" (Radovic et al., 2018, p. 10). In this view, "learning goes beyond constructing new and flexible understanding and entails becoming a different person with respect to the norms, practices, and modes of interaction determined by one's learning environment" (Bishop, 2012, p. 36). Bishop continues:

what we learn in school is much more than the disciplines of mathematics, reading, history, and science. We learn who we are. And these identities, in turn, affect not only how we learn or fail to learn the subject matter at hand but also who we become, what we pursue, what makes us happy, and what we find meaningful. (p. 36)



Identity is fluid and changeable according to contextual influences, an emergent process which can become crystallized (Radovic et al., 2018, p. 10). Researchers who share this perspective commonly use the methodologies of case study and ethnography to provide an in-depth account of learners' enacted identities (Bishop, 2012; Heyd-Metzuyanim, 2013).

### **3.6.4 Identities as afforded and constrained by local practices**

This category foregrounds particular contexts and the ways in which they provide resources that make certain identities possible. For example, Nasir and Hand (2008) show that the practice of basketball affords deep engagement to all the players across multiple dimensions. Through access to the domain, players develop a sense of the game and hone their moves. Nasir and Hand (2008) contrast the basketball court with the school mathematics classrooms that they studied. The latter offered less access to the domain, fewer opportunities to take up integral roles, and fewer chances of expressing oneself without being considered off task. Consequently, the learners who played basketball displayed strong practice-linked identities in basketball while failing to find ways to insert themselves productively into mathematics (Nasir & Hand, 2008). In brief, the environment for basketball training afforded opportunities for self-expression and self-discovery through practice, while the environment in the mathematics classroom constrained practice and engagement.

### **3.6.5 Identities as narratives**

While it shares many of the assumptions of the previous categories, the narrative approach to identity is the one that most strongly informs this study. The data gathered comprises learners' mathematical learning stories from the time they started primary school through the different classes they took to the present, including the time spent attending after school mathematics clubs. In this respect, my study is primarily aligned with the narrative perspective on identity, which allowed me to draw on learners' personal accounts of their mathematical journeys as they traversed successive landscapes of mathematics practice.

Identity as narrative is a highly topical theoretical perspective in identity research. Researchers who view identity as narrative seek to understand how learners' relationships with mathematics change as a result of their participation in Mathematics classrooms and other landscapes of practice. In this field, however, there appear to be two distinct views. A first cohort of researchers, as described by Radovic et al. (2018), view narrative as a representation of identity (e.g. Drake & Sherin, 2006; Solomon, 2012), while a second cohort view narrative as identity (Bamberg, 2004; Sfard & Prusak, 2005b). It is towards the latter view that this study leans.

Some researchers use life histories, mathematics histories and observations to understand how teachers construct their personal and professional identities within the context of primary school literacy and numeracy classes (Drake, 2006; Drake & Sherin, 2006), others employ “mathematics stories as representations of identity” (Drake, Spillane, & Hufferd-Ackles, 2001, p. 1) to understand MLIs.

I decided to align my research with the argument of Bamberg (2004) and Wortham (2004) that identities are constructed in and through the stories people tell about themselves and their experiences. For instance, Holland et al. (1998, p. 3) explain that:

People tell others who they are, but even more importantly, they tell themselves and they try to act as though they are who they say they are. These self-understandings, especially those with strong emotional resonance for the teller, are what we refer to as identities.

In the systematic review by Radovic et al. (2018), 36% of studies emphasised the representational dimension of identity operationalised in the form of narratives. Most of these studies disagree with a view of identity as a personal attribute and stress the relevance of the cultural and social resources that shape the personal narratives of mathematical learners (i.e. they acknowledge the social as a defining feature in terms of the subjective/social dimension). This coheres with cultural-historical activity theory, which views identity as emerging from engagement in joint object-oriented and socio-culturally mediated activities (Roth, Hwang, Goulart, & Lee, 2005). In other words, while subjects construct identities collectively and in response to societal (re)structuring, uncertainty plays a significant role, turning identity into a shifting, unfixed, and unending entity involving the reconstruction of meaning over space and time (Chronaki & Matos, 2014).

Radovic et al. (2018) claim that identity narratives are best seen as enactments of identity, constructed in the moment, and not as representations of an inner identity. It follows that narratives were not only the object of study but also the method of choice for data collection. This has important theoretical and methodological implications: such narratives are re-constructed during the process of recollection, thus preserving the dynamic and fluid quality of identity, which is in constant negotiation with the social (Radovic et al. 2018). Even though all studies included in this group emphasised representational (narrative) forms of identity and acknowledged that the subjective experience of identity was intrinsically related to social influences, variations in where the emphasis fell in the social/subjective dimension were observed (Radovic et al., 2018). One group of studies stressed subjective-self-understanding while another group emphasised self-positioning in discursive spaces. One group of narrative studies stressed subjective-self-understanding, self-reflection and agency in the construction of

personal histories (within social constraints). In these studies, narratives were used by learners to manage, among other things, stereotype threats (Radovic et al., 2018). The stereotype threat, the threat of being viewed through the lens of a negative stereotype or the fear of doing something that would inadvertently confirm that stereotype, suppress academic performance among Black learners at all academic levels (McGee & Martin, 2011). In the context of standardised mathematics tests in the US, (also written in South Africa), it has been shown that Black learners who are aware of derogatory stereotypes relating to their mathematics ability may experience anxiety concerning the confirmation of those stereotypes, as a result of which their performance in mathematics tests will suffer (Steele & Aronson, 1998). In South Africa, the majority of the population (who happen to be Black) suffer the same stereotype threat. Although South Africa has had more than two decades of majority rule, with ongoing attempts to achieve equity and equitable education, the two-tier system of education that dominated in the apartheid regime still exists. Spaul (2019, p. 2) argues that:

the country is a tragic petri dish illustrating how politics and policy interact with unequal starting conditions to perpetuate a system of poverty and privilege. Ultimately, we see a process unfolding where an unjustifiable and illegitimate racial education system (apartheid) morphs and evolves to one that is more justifiable and somewhat non-racial, all the while accommodating a small privileged class of South Africans who are not bound to the shared fate of their fellow citizens.

Another group of narrative studies conceptualises narratives as self-positioning in discursive spaces, thus emphasising social aspects and structural restrictions rather than individual agency (Radovic et al., 2018). In other words, the scope and limits of an individual's aspirations and "choices" are shaped by the wider social structures within which they are located, even if these forces are often not consciously recognised by the individuals themselves (Archer, Dewitt, Osborne, Dillion, Willis & Wong, 2012). As a result, narratives are conceived as a form of identity work, which captures the labour involved in negotiating dominant discourses that restrict what the individual sees as possible and/or desirable positions (Archer et al., 2012; Mendick, 2005). This perspective shows that learners' mathematics aspirations are not usually personal decisions but are societal inflections and productions and reproductions.

Studies from both groups include in their operationalisation of identities the idea that identities unfold in time (Sfard & Prusak, 2005a), extending towards the future when aspirations or motives are narrated (Archer et al., 2012; Black, Williams, Hernandez-Martinez et al., 2010).

Identities unfold as products of a temporal tension when elements of the past, present, and future become articulated in a narrative (Solomon, 2012). Since several researchers include the

perspectives of Sfard and Prusak in their studies (Bishop, 2012; Heyd-Metzuyanim, 2013), I provide, below, a synopsis of Sfard and Prusak perception of identity as narrative.

### **3.7 IDENTITIES ARE NARRATIVES, THEY ARE NOT REPRESENTED BY NARRATIVES**

While Sfard & Prusak (2005b) share many broad theoretical assumptions about the nature of learning and learner identities with key socio-cultural theorists whose work preceded theirs (such as Gee, Wenger, Holland and colleagues), they challenge these works for not providing operationalisable definitions and related explanatory and analytic tools. Thus, they note that this earlier work argues for an operational definition of identity that equates identity with significant, endorsable and reifying narratives. Sfard and Prusak (2005a, p. 14) explain that their operationalised definition of identity resulted from lengthy deliberations which led them “to the decision to equate identities with stories about persons. No, no mistake here: We did not say that identities were finding their expression in stories – we said they were stories.” Darragh (2013, p. 217) goes on to say that “we construct our mathematical identities by telling stories about our experiences of mathematics; stories that explain our actions and decisions within larger societal stories about mathematics itself.” Graven & Buytenhuys (2011) argue that this definition of identity gives increased agency to the learner as it opens a space for the re-authoring of his or her identity and allows the storyteller deliberately to challenge existing negative stories.

Sfard and Prusak (2005a, p. 45) assert that “identities are human-made and not God-given, they have authors and recipients, they are collectively shaped even if individually told, and they can change according to the authors’ and recipient’ perceptions and needs.” They thus see identity formation as a form of communicational practice (Ingram, 2015) in which identities are the stories that surround a person (Sfard & Prusak, 2005a).

Sfard and Prusak advance a critique of the definition of identity by Holland and colleagues on the grounds of its inability to provide explanatory and analytical tools for researching identity. Blummer, cited in Sfard and Prusak (2005b), points out that the available definitions of identity did not specify what one should look at when trying to pin-point identity. Specifically, the definitions did not specify how one would know identity when one saw it, or what should be excluded from the ambit of identity. Thirdly the definitions did not enable a way of accumulating knowledge about identity making. To operationalise identity and make it a tool for educational research, Sfard and Prusak (2005b, pp. 14 & 16) define identities as “those

narratives/stories about individuals that are reifying, endorsable and significant” [italics in original].

To comprehend more clearly Sfard and Prusak’s (2005b) operationalisation of identity, it is necessary to unpack the three notions of “reifying, endorsable and significant.” Reification literally means the turning of something into a thing. Sfard (2008) thus explains reifying as the transformation of an action into a state deriving from repetitive behaviour, manifesting in the use of the verbs be, have, can, and the adverbs always, never, usually in learners’ narrative stories and interviews. Heyd-Mertzuyanim and Sfard (2012, p. 131) define reification as “the discursive activity of rendering the status of an object as something that had not necessarily been treated in this way so far.” In other words, reification gives shape to an idea through writing and can enhance one’s meaning making in ways that merely discussing the idea with other people could not (Smith, Hayes, & Shea, 2017). Individuals operating within the framework of reification relate to society just as they would to natural objects (Feenberg, 2015). The notion of reification also involves producing artefacts (such as tools, words, symbols, rules, documents, concepts, theories, and so on) around which the negotiation of meaning is organised (Smith, Hayes, & Shea, 2017). Put differently, reification “provides a shortcut to communication” and also gives “form to our experiences” (Wenger, 1998, p. 58). The concept of reification gives concreteness to otherwise abstract conceptions.

According to Ingram (2015, p. 303), “stories consist of a person’s self-dialogue (thinking), spoken-out-loud stories about themselves or other people, stories told about them by other people, interactions with other people, and reactions to events.” Thus, for a story to count as endorsable, “the identity-builder, when asked, would say that it faithfully reflects the state of affairs in the world” (Sfard & Prusak, 2005b, p. 16). In other words, the story is certified correct when the person the story is about agrees that the story reflects the actual or expected state of affairs (Sfard, 2008). To supplement the endorsability of the learners’ stories in this research, follow-up interviews with learners were carried out five months after they had written down their stories. In the interviews, learners were asked to narrate their story of mathematics from the time they started school, to date. Further endorsable stories were supposed to come from the stories about learners told by their club coordinators and the interviews with their current Mathematics teachers. Gathering these stories, however, was not carried out due to the Covid-19 pandemic, which resulted in a national lockdown in South Africa and many other countries in the world.

### 3.7.1 Sfard and Prusak's notion of actual (current) and designated identities

The reifying and significant narratives about a person's multiple identities can be divided into two distinct sets, namely, actual and designated identities (Sfard & Prusak, 2005a). In later discussions Sfard indicated that she preferred to use the term current rather than actual because the term actual was read as declarative (Graven, 2012). In the discussion that follows I therefore use the term current rather than actual. Metaphorically speaking, current identities are attempts to overcome the fluidity of change by 'freezing a video clip' (Sfard & Prusak, 2005a): they enable one to come up with factual assertions or stories about a person. Current identity stories are marked by the use of I am or he is and in sentences told in the present tense for example I am bad at maths, I am a slow learner or he or she is a good mathematician (Ingram, 2015; Sfard & Prusak, 2005a). Current identities can be conceptualised as stories about how an individual has participated in mathematics (McCulloch A. W., Marshall, DeCuir-Gunby, & Caldwell, 2013). These are stories that describe the individual's practical engagement. On the other hand, designated identity stories "are believed to have the potential to become a part of one's [current] identity" (Sfard & Prusak, 2005b, p. 18). They can be recognised by their use of the future tense or of words that express wishes, commitment, obligation or necessity, such as should, ought, have to, must, want, can/cannot and so on (Sfard & Prusak, 2005b). Similarly, McCulloch et al. (2013, pp. 80-81) state that:

designated identities can include the stories about future hopes or yarns about how gifted (or ungifted) an individual is in mathematics, whether or not it is grounded in truth (e.g., I am going to do far better in geometry; I will never be able to do high school math; You are not a math person).

Furthermore, the stories usefully link affect, learning, and identity because they suggest the likelihood of unhappiness in a person when there is a perceived (and persistent) gap between his or her current and designated identities (Sfard & Prusak, 2005a; 2005b). Narratives that express explicit desires such as I want to be an engineer, or I have to be a better person are typical of designated identities. More importantly, "designated identities give direction to one's actions and influence one's deeds to a great extent, sometimes in ways that escape any rationalisation" (Sfard & Prusak, 2005b, p. 18). For example, learners may inexplicably increase their work rate in mathematics and do exceptionally well, surprising a lot of people who had held different expectations of them. Sfard and Prusak (2005b) argue that it is possible for a person to adopt certain stories:

because the person thinks that what these stories are telling is good for her, because these are the kinds of stories that seem appropriate for a person of her sociocultural origins, or

just because they present the kind of future that she is designated to have according to others, in particular according to people in the position of authority and power. (p. 18)

In such a case, a person may end up endorsing or living a certain narrative without realising that it is just a story and there are other alternatives outside his or her landscapes of practice (Sfard & Prusak, 2005b). Analysing learners' stories and interviews using current and designated dimensions helps one to understand their mathematics identity as they continue on their mathematics journey.

### **3.7.2 Learner mathematical biography and autobiography**

Sfard and Prusak (2005b) introduced and operationalised a narrative definition of identity to account for notable differences between the learning activities of high school immigrant mathematics learners from Russia and those of their native Israeli classmates. In their study, defining identity as narrative enabled them to gain an overview of how a community with its discursive traditions impinges on the mathematical learning of its members. My study similarly relies on learners' stories, also referred to as 'mathematical biography' (Kaasila, 2007a), and follow-up interactive interviews. The learners' current mathematics teachers and after school mathematics club coordinators would have, were it not for the pandemic, served as what Sfard and Prusak (2005b) refer to as significant narrators. The significant narrators tell stories about the learners and may be implicit co-authors of the learners' own designated identities (Sfard & Prusak, 2005b). While significant narrators are pertinent within a narrative-as-identity theoretical framework, I was unable to gather their stories because of Covid-19 pandemic restrictions. I discuss this further in the methodology chapter. The role of significant narrators nevertheless comes through in the learners' stories as they talk about their Mathematics teachers, after school mathematics club facilitators, family members and colleagues.

The autobiographical and biographical stories require deep thought on the part of the storyteller to become seemingly vivid, concrete, or "real." Narrating "is much more than describing events or actions; it also means relating events and actions, organising them into sequences or plots, and then attaching them to a character" (Kaasila, 2007a, p. 206). Kaasila (2007a) notes that people often develop their sense of identity by seeing themselves as protagonists in different stories. He suggests the utility of constructing the mathematical biography of a second person together with that of the first.

Darragh (2016) observes that a narrative is characterised by an internal logic and a plot, a beginning, a middle, and an end that makes sense to the narrator. Rather like discourse analysis, using Sfard and Prusak's definition of identity entails paying close attention to the language

used by narrators to interpret the meaning of their stories (Heyd-Mertzuyanim & Sfard, 2012). Thus, in most of the studies reviewed by Lutovac and Kaasila (2018) researchers subjected interviews, autobiographies, narratives and observations to detailed, close analysis for data collection. This is in line with Radovic et al.'s (2018) review that noted that research on learner identity predominantly drew on identities as narratives and thus on data collection through narratives.

In this case study, my task was to find out how learners' experiences have influenced their past and present mathematical identity. Ellsworth and Buss (2000) posited that autobiographies are effective tools for identifying changes in attitude towards mathematics and science over time. In this study, participants were asked to write their own stories as vividly as they could recollect them, remembering that the stories are not only reflective of their identity, the stories are their identity (Sfard & Prusak, 2005b; Darragh, 2016).

Although many researchers use narratives for data, the process of storytelling has its own limitations. Learners' current state of mind and the prevailing environmental conditions when they compose their stories may affect their recollection of important events. In addition, to whom learners are telling the stories can result in different narratives about themselves and their relationship with mathematics. I have to acknowledge that if the learners were asked to tell their stories to someone other than myself, they could have come up with different stories. In order to mitigate this limitation, participants in this study were interviewed five months after they had written their stories in order to endorse, qualify or refute their initial stories.

### **3.8 COMMON MATHEMATICS IDENTITY THEORETICAL AND ANALYTICAL FRAMEWORKS**

Sfard and Prusak (2005a) assert that identity serves as a kind of bridge between learning and cultural context. In other words, the sociocultural environment has significant influence on learners learning mathematics or any other subject. Identity research in mathematics education has been used to explore the phenomenon of learners' disengagement from mathematics, without falling into cognitive deficit discourses where researchers focused on the negative aspects of learners only (Graven & Heyd-Metzuyanlm, 2019). Identity research entered the field of mathematics education during what Lerman (2000) terms the social turn in mathematics education. He notes that "shifts in perspectives or the development of new paradigms in academic communities [during the social turn] are the result of a concatenation of factors within and around the community" (p. 8). Lerman explains that the social turn signalled and



illuminated the emergence into the mathematics education research community of theories that see meaning, thinking, and reasoning as products of social interaction. This is corroborated by Heyd-Metzuyanim, Lutovac and Kaasila (2016) and Graven and Heyd-Metzuyanim (2019), who note that most of the identity literature in mathematics education draws on socio-cultural perspectives and aligns with a Meadian, identity-as-action view (Darragh 2016).

In their systematic review of recent identity research, Graven and Heyd-Metzuyanim (2019) established that the common research frameworks include (but are not limited to) learning as participation (Wenger, 1998), figured worlds (Holland et al., 1998) and Solomon's (2009) mathematics as a social and cultural activity. The last-mentioned provides the analytical framework that I use in this study.

### **3.8.1 Social ecology of identity analytical framework**

The ecological metaphor provided me with a helpful lens through which to understand MLI. According to Goodnough (2010), the biological perspective of the term ecology, "refers to the study of the relationships and interactions between and among organisms and their environment." She continues that "in terms of understanding the complexities of social systems and how learning occurs, an ecological metaphor provides a means to examine the relationships among individuals and groups and the cultural, social, and historical contexts in which learning and activities occur" (p. 170). I draw on Wenger's (1998) social ecology framework to analyse participants' mathematics stories. This framework conceptualises identity as one's trajectory through the landscapes of practice, connecting the past and the future in negotiation of the present (Wenger, 1998). As Barab and Roth (2006) point out, learning and knowing do not exist simply in the world or in the individual; rather, the generation of knowledge and meaning reflects the relationship between learners and their environment. In this study, participants' journeys took them from primary school to high school, passing through after school mathematics clubs where they were exposed to MLIs that were different from the identities storied in traditional classrooms and the various social groups they belonged to. In the next section, I explain the social ecology of identity as involving the recognition of Wenger's (1998) three modes of belonging (imagining, engaging and aligning).

### **3.8.2 Wenger's three modes of belonging**

Sfard and Prusak (2005a, p. 44) argue that, "the most significant stories are often those that imply one's memberships in, or exclusions from, various communities." For this reason, I employ Wenger's (1998) three modes of belonging – imagination, engagement and alignment

– to analyse MLIs in the stories that participants tell about their mathematics trajectories. In the analysis I look for episodes in which learners talk about engagement, alignment and imagination as they journeyed through mathematics.

### ***3.8.2.1 Engagement***

Engagement “requires the ability to take part in meaningful activities and interactions, in the production of sharable artefacts, in community-building conversations, and in the negotiation of new situations” (Wenger 1998, p. 184). It involves mutuality in working on issues, reflecting, and debating in the various learning communities that learners pass through. Furthermore, engagement affords direct experience of regimes of competence, whether learners’ engagement is a visit or lifetime commitment, whether the result is an experience of competence or incompetence and whether they develop an identity of participation or non-participation (Wenger-Trayner & Wenger-Trayner, 2015).

Learners’ narratives of modes of engagement could include, for example, participants’ talk about engagement in mathematical group work with others (identity of participation) or mention how they experienced challenges that limited their engagement in mathematical group work (identity of non-participation) (Oppland-Cordell & Martin, 2015). The notion of engagement assists researchers to investigate the level of participation by individuals in different learning communities.

### ***3.8.2.2 Alignment***

Alignment is the way participants coordinate their energy and activities to fit within broader structures and contribute to broader enterprises (Wenger, 1998). Accordingly, learners’ engagement in practice is rarely effective without some degree of alignment with the context and making sure activities are coordinated, and that regulations and intentions are implemented (Wenger-Trayner & Wenger-Trayner, 2015). Furthermore, alignment “entails connecting local efforts to broader enterprises and discourses that will motivate individuals to want to invest their time and energy in meaningful ways” (Goodnough, 2010, p. 177). Alignment is also concerned with compliance with various rules and regulations in landscapes of practice, failing to do which limit learners’ engagement opportunities. Wenger uses the concepts of identification and negotiability to explain the modes of belonging.

### **3.8.2.3 Imagination**

Imagination is the last mode of belonging in Wenger's analytical framework that I use to investigate evidence of learners' participation in various learning communities, including after school clubs. Imagination "refers to a process of expanding our self by transcending our time and space and creating new images of the world and ourselves" (Wenger, 1998, p. 176). Learners use such images of the world to locate and orient themselves, to see themselves from a different perspective, to reflect on their situation, and to explore new possibilities (Wenger-Trayner & Wenger-Trayner, 2015). Imagination allows learners to conceive their participation and envision possible futures relating to the application of mathematics in real life (Pausigere, 2014). The exercise of imagination can lead to engagement.

## **3.9 IDENTIFICATION AND NEGOTIABILITY**

Wenger (1998) states that identification is the process through which modes of belonging (imagination, engagement and alignment) become ingrained in learners' identities through the creation of bonds or distinctions in which they become invested. In other words, identification is the action of constructing multiple identities to bring out the continuously shifting possibilities for new constructions, which arise with changes in discourse when individuals meet in a social realm (Stentoft & Valero, 2009). Wenger goes on to explain that it may include reifying a group of learners in a landscape of practice; being identified as a member of a group and identifying with the group in a personal way, with a deep experience of allegiance. The process of identification, adds Wenger (1998), can be both positive and negative, in the sense that it incorporates relations that mould what we are and what we are not, what we enjoy and what we fear, and it engenders identities of both participation and non-participation.

Threats to individuals' identification with and within the group are real and result from some voices being valued over others in the eyes of different learners, including those of their Mathematics teachers and club facilitator, as all participants engage in the struggle for control and ownership of meaning (Waycott, Thompson, Sheard, & Clerehan, 2017). Some learners will be privileged by having adequate negotiation skills to participate meaningfully, while other members of the same landscape of practice will not be able to participate meaningfully.

### **3.9.1 Negotiability**

According to Wenger (1998), the process of negotiability refers to the ability, facility, and legitimacy associated with contributing to, taking responsibility for, and shaping the meanings

that matter within social configurations or landscapes of practice. Put differently, it is the degree to which learners take control over the meanings of activities in which they are invested or in which they are participating. Negotiability allows learners to make meanings applicable to new circumstances, and to enlist the collaboration of others in the group to embrace the new meanings (Wenger, 1998). However, “not all group members will be endowed with sufficient power of negotiability to participate meaningfully, which may result in some group members feeling disempowered” and exhibiting identities of non-participation (Waycott et al., 2017, p. 14). My fourth research question, how does participation in after school clubs feature (if at all) in learners MLIs, will be answered when learners interrogate their interaction or participation in the landscapes of practice through which they have passed in their mathematics journeys to date.

Table 3.2 provides the social ecology of identity framework, with explanations of how these may feature in the stories

Table 3.2 Social Ecology of Identity Framework

| <b>Mode of belonging</b> | <b>IDENTIFICATION</b>                                                             |                                                                       | <b>NEGOTIABILITY</b>                                                                                                  |                                                                                                                     |
|--------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
|                          | <b>Identities of participation</b>                                                | <b>Identities of non-participation</b>                                | <b>Identities of participation</b>                                                                                    | <b>Identities of non-participation</b>                                                                              |
| Engagement               | Participation in the landscapes of mathematical practice with others              | Experiencing challenges that limit participation                      | Having one's ideas adopted by the group                                                                               | Marginalisation through having one's ideas ignored                                                                  |
| Imagination              | Feeling enthralled by the various mathematical games/activities                   | Failure to get excited by the games/activities on offer               | Perceiving self as having understanding of mathematical concepts worth sharing in landscapes of mathematical practice | Assuming that fellow members in landscapes of mathematical practice have stronger ownership of mathematics concepts |
| Alignment                | Pledging allegiance to the landscapes of mathematical practice by following norms | Violating norms and values of the landscapes of mathematical practice | Coordinating enterprises across context to strengthen                                                                 | Copying someone's work without contributing or understanding                                                        |

|  |                                                                             |  |                          |  |
|--|-----------------------------------------------------------------------------|--|--------------------------|--|
|  | and values (e.g. listening to others' contributions and engaging with them) |  | ownership of mathematics |  |
|--|-----------------------------------------------------------------------------|--|--------------------------|--|

Adapted from Wenger (1998) and Oppland-Cordell & Martin (2015)

I also use the concept of figured worlds in the analysis of learners' stories, which I explain in the next section.

### 3.9.2 Figured worlds

Holland et al. (1998) define a figured world as “a socially and culturally constructed realm of interpretation in which particular characters and actors are recognized, significance is assigned to certain acts, and particular outcomes are valued over others” (p. 52). In terms of this framework, mathematical identities thus refer both to the self-understandings that learners develop about their relationship to the subject of mathematics, and to the understandings that are assigned to them through their position and encounters in the social world (Holland et al., 1998).

The framework focuses on how people participate in socially and culturally constructed contexts (Holland et al., 1998) such as after school mathematics clubs, classrooms, professional development workshops, and so on. In my study, activities within the figured worlds of classrooms and after school mathematics clubs derive their meaning from the clubs and the various mathematics classrooms. They occurred at times when and in places where I was not present to observe and ask the participants to record daily or weekly reflections. In order to understand learners' activities in the different figured worlds in which they participated, I therefore asked them to write for me the story of their mathematical journey from the time they started primary school to present, passing through a range of figured worlds. These stories are their MLIs.

### 3.9.3 Literature on mathematical beliefs

While my research is located squarely within the theoretical framework of identity-as-narrative, there is a large body of research on the relationship between identity and beliefs, notably Attitudes, beliefs, motivation and identity in mathematics education: An overview of the field and future directions (Goldin, Hannula, Heyd-Metzuyanim, Jansen, & Kaasila, 2016). As the title suggests, the book usefully juxtaposes three key aspects with identity, but more pertinent to my purposes is Solomon's *Mathematical Literacy: Developing Identities of*

Inclusion (2009). The categories identified by Solomon, which categorise identity stories linked to learners' beliefs and perceptions, resonated strongly with themes that emerged in my reading of learners' narratives and the follow-up interviews (see Hokonya, Vale & Graven, 2020).

The first category is learners' stories about the nature of mathematics, where learners' narratives show that they come to school with preconceived notions about the nature of mathematics garnered from their social networks. The second category relates to learners' stories about themselves as mathematics learners. The third addresses learners' stories of participation or engagement in mathematics activities. The fourth category refers to learners' stories about their perceptions of how others in their landscapes of practice perceive them as mathematics learners, while the fifth relates to stories about the perception of self as a potential participant in mathematics. This category relates to learners' introspective discourses about themselves as doers of mathematics (Martin, 2012). Solomon reiterates the view of Wenger (1998) that social participation shapes our interpretation of the world and our actions. As learners interact with others in a shared landscape of practice, they undergo experiences that influence the construction of their mathematical identities or stories. More detailed discussion of three of Solomon's (2009) categories most germane to this study ensues.

### ***3.9.3.1 Stories about the nature of mathematics***

Learners' stories about the nature of mathematics have far-reaching effects on their learning of the subject. To begin with, when learners choose Mathematics, they are obliged to redefine themselves, making a public statement about what sort of person they are and hope to be (Shaw, 1995). Hammer and Elby (2002) argue that mathematical epistemologies are sensitive to context and domain and are more usefully characterised in terms of more primitive epistemological resources for understanding the nature and sources of knowledge, epistemic activities and forms, and epistemological stances. This seems imperative for learners as they tell their stories about the nature of mathematics, for usually what learners believe about the nature of mathematics pushes them into engaging (or not) as fully-fledged members of learning communities.

Research on mathematics in education characterises the subject as having a gatekeeper effect in the lives of learners as they progress (Sfard & Prusak, 2005b; Martin 2006), "learners who choose not to study mathematics, or who fail to gain basic secondary mathematics qualifications, have, as a result, more limited life and work choices" (Darragh, 2013, p. 215).

In the same vein, Mendick (2006, p. 17) frames Mathematics as “a route to economic and personal power within advanced capitalism.” The image of mathematics as a gatekeeper emerges in the learners’ stories, where its monumental importance as a subject seems to mean that it is difficult to comprehend. Schoenfeld (1992, p. 359) notes that the importance attached to the subject leads learners to believe that “ordinary students cannot expect to understand mathematics...” but are simply expected to “memorise it and apply what they have learned mechanically and without understanding.” He continues to observe that “the mathematics learned in school has little or nothing to do with the real world” (p. 359), which makes it seem appropriate simply to memorise mathematical concepts and recall them in terminal examinations, pass the examinations and get better employment in the future.

Another story about the nature of mathematics that affects MLI is that mathematics is:

... associated with certainty, and with being able to give quickly the correct answer; doing mathematics corresponds to following rules prescribed by the teacher; knowing mathematics means being able to recall and use the correct rule when asked by the teacher; and an answer to a mathematical question or problem becomes true when it is approved by the authority of the teacher” (Corte, Eynde, & Verschaffel, 2002, p. 305).

This resonates with Lampert’s (1990) and Schoenfeld’s (1992) views that some learners believe that mathematics problems have only one right answer, and that there is only one correct way to solve any mathematics problem – usually the rule the teacher has most recently demonstrated to the class. In other words, following the rules provided by the teacher means doing mathematics, and remembering and applying the rules correctly means knowing mathematics (Mason, 2003). In fact, Borba and Skovsmose (1997, p. 17) state that “mathematics is often portrayed as a stable and unquestionable instrument/structure in a very unstable world,” requiring no creativity and involving little more than repetition of the teacher’s methods of calculating the answers.

However, the after school mathematics clubs attended by participants in this study presented contrasting perspectives on the nature of mathematics, in which learners were encouraged to be creative, to create their own mathematics and use various methods to solve problems. In the after school mathematics clubs, learners were allowed to “be the experts in their own lives” (Gay, 2010). This echoes Schoenfeld’s (2017, p. 423) exhortation to teachers to encourage learners “to come to see themselves as mathematically capable and competent – not by giving them easy success, but by engaging them as sense-makers, problem solvers, and creators of mathematical ideas.”

In support of this view, the South African Mathematics syllabus encourages the use of critical and creative thinking in making decisions of identification and solving problems. The perspective is rooted in constructivist approaches that are averse to the traditional and positivist view of mathematics. Constructivism emphasises the role of the classroom community in supporting learners' learning via conjecture, experiment, argument and justification (Cobb 2003; Maher, 2005). The hallmark of such classroom communities is that they are designed to produce learning of significant mathematical ideas as learners participate in them and contribute to their evolution (Cobb, 2003). Thus, learners in Mason's (2003) study believe that not all problems can be solved by applying step-by-step procedures; they maintain that mathematics is useful for everyday life, and that conceptual understanding is important. Learners should always work from a social constructivist perspective, understanding that for all its wonder, mathematics, like everything else, remains a set of human practices grounded in the material world we co-inhabit and co-construct (Ernest, 1998).

In short, learners' stories about the nature of mathematics have far-reaching effects on learners' engagement and their MLIs.

### ***3.9.3.2 Stories about themselves as mathematics learners***

Learning mathematics relies on how learners' position and 'tell' themselves as mathematics learners in the classroom (Solomon, 2007; 2008). When learners are active agents in the discourses involved, they contribute to negotiations about what it means to be mathematics learners and to know and do mathematics in the classroom (Norén, 2011). Learner agency builds self-efficacy in learning mathematics. According to Bandura (1997), self-efficacy stories lie at the core of human functioning, defining self-efficacy as people's judgments of their ability to organise and execute courses of action required to achieve designated types of performance. It is not enough for learners to possess the requisite knowledge and skills to perform a task; they also must have the conviction that they can successfully perform the required behaviour(s) under typical and, more importantly, challenging circumstances (Artino, 2012). For this reason, self-efficacy stories can also be understood as self-judgment of one's imaginative capacity and perceived competence in generating novel and adaptive ideas, solutions, and behaviours (Tierney & Farmer, 2002; Beghetto, 2006).

Stories of confidence in one's ability to generate new and meaningful ideas seem necessary for the development of mathematical understanding. As Bandura (1997) asserts, mathematics endeavours require "an unshakeable sense of efficacy to persist" (p. 239) in a learner.



Successful adaptation to school requires that learners develop stories of self-regulation, or processes that activate and sustain cognitions, behaviours, and affects that are oriented toward goal attainment (Zimmerman, 1990). Narratives of self-regulation also incorporate motivational processes such as holding positive stories about one's capabilities, valuing learning and its anticipated outcomes, and experiencing positive affects (such as pride and satisfaction) about one's own efforts (Schunk, 1994). Dispositions (identities) and stories that learners narrate about themselves as learners can deeply influence their choices about how to engage in the classroom (Nasir 2002). For example, if learners story themselves as "mathematics people", they are likely to take risks in learning new things. Oyserman, Elmore and Smith (2012) note that a learner's self-identity is deeply held and defended against experiences that contradict it. Learners with positive self-identity narratives consequently develop the kind of positive mathematical identities that are essential to learning mathematics.

Some learners present themselves as "stupid", "dumb" or "slow" in the stories they tell about themselves as mathematics learners (Rogers, 2017, 2009; Usher, 2009). These learners are likely to have developed identities as non-mathematics learners as a result of being isolated in remedial classes for so long by a system that equates competence with test scores (Aguirre, Mayfield-Ingram, & Martin, 2013). The learners may have reached the stage of concluding that they cannot learn mathematics because every time they try their results are not good enough. Such learners develop hatred for the subject and find ways to justify the idea that they just cannot succeed in Mathematics.

### **3.10 MYTHS ABOUT MATHEMATICS LEARNING**

There are several damaging and pervasive myths about mathematics learning that are believed by millions of school learners, their parents and their teachers the world over (Boaler, Dieckmann, Perez-Núñez, Sun, & Williams, 2018). The myth that some people are born with a "mathematics brain" and some are not, and that high achievement is only available to some learners, significantly stifles and reduces achievement (Boaler, 2016). Two areas of mathematics education research have challenged this myth: first, Maguire et al. (2000) have illuminated the plasticity of the brain, revealing how brains can grow and change; and secondly, Dweck (2006) has argued that when people change their mind-set about the malleability of their potential, from "fixed" (my ability is not changeable) to "growth" (my ability changes as I learn), their learning and achievement in mathematics improves commensurately.

Another damaging myth is the idea that mathematics learning is all about procedures and memorisation, rather than ideas, concepts, and creativity (Boaler et al., 2018), such that learners who are not good at rote learning dare not attempt the subject at all. Contrary to the perception that rote memorisation is key to mathematics success, research reveal that learners who approach mathematics as a subject for memorisation are lower achieving than those who approach it as a subject consisting of ideas that they can think deeply about and to which they can apply different and creative methodologies (Boaler & Zoido, 2016). Lastly, Boaler (2016) dismisses another myth popular among learners that good mathematics learners have to be fast in finding answers, given that some of the world's leading mathematicians are slow thinkers.

### **3.11 DEVELOPING MATHEMATICAL LEARNER IDENTITY**

MLIs are constructed out of various discourses available in the Mathematics classroom (Norén, 2011). According to Walshaw (2007, p. 81), identity is “created at the intersection of a multiplicity of discourses, always criss-crossing each other.” This suggests that mathematical identities are not static but are dynamic and complex phenomena that are continuously constructed through social interactions (Oppland-Cordell & Martin, 2015). Norén (2011) describes mathematical identities temporary, slippery and shifting. The mathematics learner is a product of the culture of the landscape of practice, and as a person is constantly changing in response to cultural dynamics. Resulting from social interactions, negotiations and power relations, identity is a relational concept (Selander & Aamotsbakken, 2009), a constantly ongoing and unstable process of becoming (Grootenboer, Smith, & Lowrie, 2006).

There is nevertheless a general view that identities in mathematics education emerge as “natural givens and biological determinants” (Sfard & Prusak, 2005b, p.15) for certain learners. Explaining the phenomenon of ‘born mathematicians’, Anderson (2007) claims that some learners relate more immediately to mathematics because the subject is somehow inscribed in their makeup or genes. Learners who under-achieve in mathematics “have no control” (Anderson, 2007, p. 10) over improving their comprehension and knowledge of the subject. Johnston (2012) repudiates this notion that some learners are ‘born mathematicians’ by stating that identity in mathematics is not fixed for a few lucky learners. Instead, everyone has the mathematics gene (Devlin, 2000). Mathematical aptitude is not the preserve of a few learners; on the contrary, all learners are able to learn and pass the subject.

Together with the acceptance of identity as the pivotal notion of the new educational research discourse comes the recognition of humans as active agents who play decisive roles in

determining the dynamics of social life and shaping individual activities (Sfard & Prusak, 2005b). There are several reasons for the growing interest in MLIs. For example, exploring how learners identify with mathematics can offer valuable insights into the affective aspects of the relationship of the learner or teacher with mathematics (Hannula, 2012), and explain how a personal relationship with the subject develops over time (e.g., Walls, 2009). Perhaps more importantly, identity can be a useful tool in exploring learners' difficulties in engaging with mathematical activity (Solomon, 2007), or in understanding how identifying with certain social categories (e.g., gender, race) can negatively influence mathematical engagement (e.g., Nasir & Cobb, 2007).

MLIs affect learner success and influence life-long decision making. In recent years, there has been increasing research interest in MLI as a means of understanding learner engagement with (or disengagement from) mathematics (Sfard & Prusak, 2005a, 2005b; Solomon, 2007). It has been shown that what is key to the learners' relationship with mathematics is their evolving sense of self and their understanding of how mathematics fits with this (Mendick, 2006).

A knowledge of MLIs is fundamental because it provides indicators to mathematics teachers about pedagogical approaches that will resonate with their learners. Boaler and Greeno (2000) note that learners studying in different learning environments – such as lecture-based, problem-solving and group work-based learning – develop different mathematical identities. Since mathematical identities encompass learners' life histories, affective qualities and cognitive dimensions, research on MLIs provides insight into the persistent problems of mathematical disengagement and underachievement (Grootenboer & Zevenbergen, 2008).

Mathematical identity encompasses dispositions and beliefs that learners develop about their ability to participate and perform effectively in mathematics contexts (Martins, 2009), which is why I turn now to the question of how positive MLIs boost self-motivation and confidence while enhancing self-belief and persistence in learning mathematics.

### **3.11.1 Positive mathematical identity boosts self-motivation**

The relationship that learners have with mathematics is not innate but rather the result of their interaction with the mathematical milieu that they grow up in. MLIs are therefore determined by the learner's environment. According to Sfard and Prusak (2005), identity points to the way individuals see themselves and how others define them relative to their life experiences and aspirations. Identities are therefore not realised in isolation but constructed "through the activities and in relation to the social types that populate [one's] figured worlds and in social

relationships with the people who perform these worlds” (Urrieta, 2007, p. 108). MLIs are critical in the learning of mathematics because they determine the effort that learners are prepared to put into the acquisition of mathematical concepts regardless of the seemingly difficult and challenging moments. Additionally, MLIs try to answer the questions, “What is it that makes some students learn mathematics willingly and with interest while leaving many of their peers indifferent if not openly resistant? How does this difference influence the learning practices of the student?” (Sfard & Prusak, 2005a, p. 37).

Among other things, identity expresses one’s self-construal (Weinreich, 1986). Learners who construe themselves as having positive identities towards the study of mathematics are generally self-motivated. Self-motivation is imperative in the learning of mathematics and all other subjects at school. Motivation is a psychological process that gives purpose, direction and intensity to behaviour and is mainly responsible for differential work output in learners (Mwangi & McCaslin, 1994). Motivation guides not only performance in school and but also subsequent educational and career choices (Wang, Chow, Degol, & Eccles, 2017).

### **3.11.2 Confidence, beliefs and persistence**

Learners in studies by Burton (2004) and Darragh (2013) spoke about confidence in different ways during interviews. Some learners linked confidence to actual behaviour like putting up a hand to answer or ask a question, or sometimes even to argue with the teacher, while others maintained that confident behaviour resulted from the overcoming of fear or shyness. Some suggested that confidence came from the certainty that one had the right answer, in other words, that it was a reflection of one’s level of trust in one’s mathematical responses (Sander & Sanders, 2009).

Beliefs are personal views and judgements formed by past experiences (Eleftherios & Theodosios, 2007), for example the judgment that Mathematics is valuable and worth trying at regardless of the difficulties it presents. Learners’ confidence, beliefs and persistence (Bishop, 2012) are closely related to and reflect their mathematical identities. Gweshe and Brodie (2019) reiterate that if learners have confidence in their mathematical abilities, they are likely to persist, learn and form positive mathematical identities. When learners are persistent, they are also likely to learn, gain confidence and develop positive mathematical identities.

Two forms of mathematical identity that depend on the strength of a person’s relationship with mathematics have been distinguished in identity literature as closely linked to confidence, beliefs and persistence in mathematics learning: robust and fragile identities (McGee, 2015).

Robust identities relate to positive mathematical experiences and are largely intrinsically motivated while fragile identities are consequent on negative mathematical experiences and are extrinsically motivated (McGee, 2015). Robust and positive mathematical identities draw together persistence, an interest in mathematics, and the motivation to learn mathematics. Persistence refers to not giving up on mathematics when faced with challenging mathematical problems and reflects a determined struggle to solve them (Boaler & Selling, 2017).

Learners with robust identities have growth-orientated mindsets, which seem to give them the resilience to persist through challenges (Yeager & Dweck, 2012) and help them navigate the difficult mathematical transition from primary to high school and beyond (Blackwell et al., 2007). Boaler (2002) argues that the mathematical practices learners engage in, shape not only their mathematical identity, but the “disciplinary relationships” (p. 119) they develop with the subject. Therefore, learners with positive mathematical identities believe themselves to be talented in mathematics and capable of doing well in the future. They experience mathematics as easy and enjoy the subject (Roesken, Hannula & Pehkonen, 2011).

A learner nurtured to believe that ability is something you cannot change, is said to have a fixed mindset, or an entity theory of intelligence (Dweck, 2006). Once learners’ stories about themselves born of a fixed mind-set have been assessed, suitable educational interventions should be planned and implemented in the classroom to gradually change naive representations about the nature and acquisition of knowledge in mathematics – which can be very resistant to transformation (Mason, 2003). Such interventions would seek to inculcate in mathematics learners the narrative that ability is malleable, and instil a growth-orientated mind-set, or an incremental theory of intelligence to help them in their future interactions with the subject (Dweck, 2006).

Identities are thus salient factors that mould learning and influence its effectiveness. Learners with positive mathematical identities are known to be resilient in their work (Sfard & Prusak, 2005). Such learners are seldom quitters and usually succeed in meeting the mathematical challenges they come across in and out of the school learning environment. These learners grow into independent, critical thinkers and – importantly – develop effective mathematical communication skills.

### **3.12 CURRENT STATE OF THE FIELD OF IDENTITY RESEARCH**

There are several recent reviews of identity literature in the field of mathematics education generally, or specifically focused on MLI or mathematics teacher identity (see Darragh, 2016;

Radovic et al., 2018; Graven & Heyd-Metzuyanim, 2019). Darragh’s review shows that the bulk of research has been carried out in the United States of America, the United Kingdom [UK] and Europe, with only 5% in South Africa and none from any other African countries. Graven and Heyd-Metzuyanim (2019, p. 6) found the regional distribution of empirical articles by country “dominated by Northern America (12) (10 from USA and 2 from Canada); UK (6); and Europe (6) with South America (Chile/Argentina) (2); South Africa (4); Australia and New Zealand (2) and Israel (2) also contributing.” Empirical evidence from the three systematic reviews “confirms that research on mathematics identity continues to be regionally clustered rather than being a global area of research” (Graven & Heyd-Metzuyanim, 2019, p. 7). The small number of research articles from South Africa and Africa indicates a gap in the field and provides motivation for this research.

### **3.12.1 Opportunities for developing positive mathematical identities**

Martin (2012) queries the ideological elements that generate and sustain the cruel reality of racism and economic oppression in the mathematics education of marginalised learners. Marginalised learners possess the intellectual capacity to learn mathematics as well as any other learners when given appropriate resources to learn and an environment conducive to positive MLIs. Martin (2012) calls for research into teaching and learning methods that can promote marginalised/Black learners’ mathematical knowledge, identity, and agency.

In what may be seen as a response to this call, Boaler and Selling’s (2017) research follows groups of learners, post school, who were part of two classroom communities, one of which focused on traditional and procedural teaching methods and the other of which emphasised problem solving, the discussion of ideas, and the application of methods. Their findings reveal that allowing participative opportunities in the classroom resulted in enhanced mathematical understanding, higher achievement in tests and the development of active approaches to knowledge. The analyses of examination scores of learners from the participative learning community “showed that there were no achievement differences in mathematics by gender, ethnicity, or social class, an unusual important achievement for a school” (p. 81).

South African mathematics education is blighted by the after-effects of the apartheid educational system, which continue to marginalise the majority Black population. The country’s participation in large-scale international studies indicates that it has the largest performance gaps between wealthier (and often white) schools and poorer schools. The learners who participated in my research are Blacks who were marginalised under apartheid and come

from the poorer schools where performance is well below national expectations. The study seeks to explore and understand MLIs of these learners who, while learning mathematics in poorer and underperforming schools, have had the opportunity to participate in a primary after school mathematics learning community.

### **3.12.2 After school math programmes and MLIs**

Research by Berry (2008) focuses on the MLIs of under-privileged African American male learners, and the obstacles they encounter in their mathematical journeys. It explores how they overcome these obstacles to become successful mathematics learners. All the boys (who participated in special programmes that challenged traditional pedagogies) reported that the rapport between them and their teachers allowed them to be active participants in the classroom. Berry (2008) argues that participation in special programmes enabled the boys to acquire a web of support in which they developed personal, social, and academic connections leading to positive academic and social outcomes. Access to and participation in special programmes (where learner agency and active participation are foregrounded) assist learners to develop positive MLIs.

Anderson (2007) argues for developing and supporting learners' positive identities as mathematics learners, that is, so that they can develop into members of a community that nurtures the practices of mathematics learning. Beesley, Fancsali and Gulemetova (2018) suggest that out-of-school time experiences may build positive mathematics identity in struggling learners because the pressure to perform for grades and scores is absent. Activities in after school mathematical programmes may increase learners' access to mathematical content and discourse and build their identity as knowers/doers of mathematics, thereby also building their self-esteem (Cobb & Gresalfi, 2006). A positive mathematics identity should translate into higher achievement in the classroom. Solomon, Croft, and Lawson (2010) have documented that mathematics support centres appear to have a significant impact on discourses of ability and learning: they lead in particular to an appreciation of collaborative work and to a shift in attitudes towards mathematics as a community of enquiry, as opposed to an individual performance-oriented pursuit.

Other research shows that after school programmes produce multiple benefits pertaining to learners' personal, social and academic life (Durlak & Weissberg, 2007). The benefits include improving feelings of self-confidence and self-esteem, school bonding (positive feelings and attitudes towards school), positive social behaviours, and higher school grades and

achievement test scores (Durlak, Weissberg & Pachan, 2010; Durlak, Weissberg, Dymnicki, Taylor, & Schelling, 2011). Importantly, out-of-school activities not only benefit the academic life of learners, but help them to learn how to combine, chain, and sequence behaviours that make up social skills (Gresham, 1995).

Learners who are more self-aware and confident about their learning capacities try harder and persist at all levels of mathematics education in the face of challenges (Aronson, 2002). They set high academic goals, have self-discipline, motivate themselves, manage their stress, organise their approach to work, learn more and get better grades (Duckworth & Seligman, 2005; Elliot & Dweck, 2005). It is therefore essential to develop effective instruction in mathematics clubs in terms of which coordinators carefully select problems, materials, and group practices, provide opportunities for mathematics discourse, and use assessment practices designed to provoke and support learner thinking (Sutton & Krueger, 2002).

The foundation to fostering problem-solving skills is laid in the formulation of after school mathematics clubs' planning and setting of objectives. According to Granger et al. (2007, p.7), the developers of observational instruments agree that being explicit about programme goals, implementing activities focused on those goals, and getting youth actively involved are characteristic of effective programmes. A close reading of the SANCP objectives shows how learner interaction is embedded in club activities.

### **3.12.3 Mathematical Learner Identities of marginalised learners in South Africa**

Locally, Gweshe and Brodie (2019) have investigated the MLIs of underprivileged Grade 10 learners in a South African township, seeking to establish what influences the learners' mathematical identities. The study collated a single term's test score, covering topics taught over a period of two months, for each learner and compared these to identity questionnaire results. The questionnaire included statements such as:

1. I am confident with mathematics
2. If it was up to me, I would continue with mathematics next year
3. Working hard can make you good at maths.

Learners chose responses ranging from strongly agree, coded as 5, to strongly disagree, coded as 1. The study's findings show that learners can hold largely robust, modest or largely fragile mathematical identities. Gweshe and Brodie (2019) observe that past and present mathematical experiences, what family members and peers have said about the learners and about mathematics, including peer labelling, were constitutive of the learners' identities. The learners



on whom they focus in their study (two high and two low achievers) evinced different mathematical identities and highlighted the contestations, contradictions and therefore complexities associated with identities (Hall, Towers, & Martin, 2018), as well as the challenge of describing them. Gweshe and Brodie (2019, p. 260) also observe that “some of the influences on the learners’ mathematical identities revealed in the interviews were pleasing others, gaining prestige and accessing career opportunities associated with mathematics, adding nuance to our understanding of learners’ identities.” Lastly, they found out that “mathematical identity formation is a constant social negotiation, in that learners chose to allow or refuse their past or present mathematical experiences to influence their identities” (p. 261) (see McGee, 2015; Varelas et al., 2012). Whereas Gweshe and Brodie’s (2019) study covered MLIs over a period of about two months, my study straddles the over seven-year period that took learners from primary school to high school.

#### **3.12.4 Focus on mathematics identity in this study**

Sfard and Prusak (2005a, p. 47) remind us of the importance of MLIs: “with their tendency to act as self-fulfilling prophecies, identities are likely to play a critical role in determining whether the process of learning will end with what counts as success or with what is regarded as failure.” MLIs are a significant tool in understanding learners’ difficulties in engaging with mathematical activities (Solomon, 2007).

This study focuses exclusively on understanding the MLIs of high school learners who participated in after school mathematics clubs that prioritised a different pedagogical approach from that offered in traditional primary school classrooms. The studies by Darragh (2016) and Graven and Heyd-Metzuyanim (2019) report that of the articles they reviewed, slightly more than half focus on MLIs from primary school learners through to university students. Most of the remaining articles (45% in Darragh, 2016; 32% in Graven & Heyd Metzuyanim, 2019) focus on teachers’ and mentors’ mathematical identities. The review by Radovic et al. (2018) focuses exclusively on MLIs. Within their sample, 51% of the articles addressed the identities of school-going learners, with most of them (57%) focusing on high school learners. The unique contribution of this research project is to consider the narrative identity of learners for the entire span of their mathematical learning, from primary school through to their current high school identity. There is also the consideration that, so far, there has been little research in South Africa and Africa more broadly that privileges the voices of learners.

#### **3.13 SUMMARY**

In this chapter I have outlined the historical development of the concept of identity in the academic world and highlighted that as a concept it can be slippery and sometimes vague. Identity researchers have produced a variety of definitions of the concept. According to Darragh (2016), broadly speaking, researchers in the identity field define identity in one of five different ways: participative, narrative, discursive, psychoanalytic and performative. My study veers towards the definition that characterises identities as narratives; the aim was to explore the narratives of mathematical identity of learners whose common background is that of attending after school mathematics clubs in primary school

There are various dimensions of identity in mathematics education research and a range of different conceptual and methodological emphases in approaches to identity. The chapter discussed some of the common research frameworks used in identity research and explained the analytical framework for this research. I focused on three of the five strands from Solomon's categories of learner's mathematics identities, which look at:

1. learners' stories about the nature of mathematics
2. stories about themselves as mathematics learners
3. engagement in mathematics activities.

I explained the analytical frameworks provided by figured worlds and Wenger's modes of belonging. I also discussed important facets of positive MLIs, which include the development of academic aptitudes and social skills that are invaluable to learners as they are growing up and in their adult lives. Positive mathematical identities also lead to the development of problem-solving skills, self-esteem and effective communication skills.

## **CHAPTER 4**

### **RESEARCH ORIENTATION AND METHODOLOGY**

#### **4.1 INTRODUCTION**

This chapter discusses the research orientation of the study and the methodology employed. I explain the importance of qualitative research methods for my exploration of the mathematics identities of learners who participated in after school mathematics clubs. The chapter also provides detailed information about the research site, participants in the study, data collection methods and analysis. It concludes with a discussion of key methodological issues concerning ethics and the validity and reliability of the data.

#### **4.2 RESEARCH ORIENTATION**

All research is underpinned by certain philosophical perspectives that formalise the assumptions that I am making about my research, assumptions that determine – directly or indirectly – the choice of research paradigm, methodology, and modes of data collection, analysis and interpretation (Crotty 1998). Philosophical perspectives determine how a researcher derives meaning from the data gathered and thus creates knowledge (Moon & Blackman, 2014). This research study is informed by the interpretive research paradigm.

##### **4.2.1 Interpretivism as ontology**

According to Tobin (2000) interpretivism is an umbrella term used to describe studies that endeavour to understand a community in terms of the actions and interactions of the participants. Moon and Blackman (2014) point out that interpretivism shares the beliefs of subjectivism and relativism about the nature of knowing and reality. It draws on a relativist ontology to assume that reality is constructed intersubjectively through the meanings and understandings developed socially and experientially. Put differently, the interpretive paradigm explains that reality is not ‘out there,’ but exists in the human mind and is conditional upon human experiences and interpretation (Lotz-Sisitka, Fien, & Ketlhoilwe, 2013). Reality, therefore, is not static but evolves and changes over time. The interpretive paradigm, according to Moon and Blackman (2014), shares the subjectivist notion that we cannot separate ourselves from what we know, and that reality can be expressed in a range of symbols and language systems that are familiar in context concerned.

The entity under investigation in this study is the mathematics learner identity (MLI) of learners who participated in three after school mathematics clubs in primary schools in Makhandia. Since people impose meaning on the world and interpret it in a way that makes sense to them (Moon & Blackman, 2014), each MLI is independent, socially constructed, fluid and malleable. In this study, MLIs are essentially jointly created by the researcher and participant through his subjective interpretation of the activities of individual learners.

#### **4.2.2 Interpretivist epistemology**

Epistemologically, MLIs are constructed through the interaction of learners in different learning communities that include the after school clubs, with their pedagogy foregrounding learner participation. Interpretivist epistemology rejects the notion that objective ‘truth’ exists ‘out there’ and is simply waiting to be discovered. Instead, it emphasises that knowledge and understanding emerge through the experiences of the actors in their social context (Merriam, 2001; Neuman, 2009). Reality is thus constructed through the interaction of people (including researchers) and the objects of inquiry (Lotz-Sisitka et al., 2013), and ‘truth’ arises in and out of our engagement with the realities in our world. These realities need to be interpreted to establish the underlying meaning of phenomena.

Interpretivists allow that in this quest for understanding, different people may construct meaning in different ways, even in relation to the same phenomenon (Crotty, 1998). Lotz-Sisitka et al. (2013) agree that, in the interpretivist paradigm, the assessment of phenomena is subjective, since reality is not independent but socially constructed. Briefly to apply this notion to my argument, although the respondents in my study went through the same context of SANCP-run after school mathematics clubs, they may well have constructed different MLIs. Fostering a dialogue between myself and the respondents is critical since it is through this dialectical process that understanding of the social world is created. The findings of my study resulted from the various dialogues that I had with the learners.

#### **4.2.3 Interpretivist methodology**

Methodology here means the overall approach to the research, rather than the specific methods used for data collection (MacKenzie & Knipe, 2006; Schensul, 2008). It is a perspective on the research that dictates how the research is approached and carried out (Howell, 2013). It forms the frame of reference for the research design and is therefore strongly linked to the chosen research paradigm and underlying epistemology (MacKenzie & Knipe, 2006).

In this research I employ an interpretivist methodology. According to Schensul (2008, p. 517) interpretivist methodologies “focus on the meanings attributed to events, places, behaviours and interactions, people, and artefacts.” In an interpretive study the researcher makes a personal assessment as to which description or attributed meaning best fits the situation, or which emerging themes capture the major categories of given information (Creswell, 2012).

Sfard (2001) argues that, although the interpretation of narrative stories should try to be compelling, cogent, and as trustworthy as possible, it will nevertheless always remain subject to questioning and modification. In my interpretation of learners’ stories, I cannot make claims regarding either the exclusivity or completeness of the mathematics identities ascribed to them. My tentativeness is an endemic property of interpretation, and the coexistence of alternative or complementary interpretations is part and parcel of the interpretive paradigm (Sfard, 2001).

#### **4.2.4 Case study research**

According to Creswell (2007), methodologies in research studies that employ the interpretive, qualitative paradigm include, but are not limited to, survey research, grounded theory, ethnography, and case study. My endeavour to understand the MLIs of high school learners who participated in three after school mathematics clubs in Makhanda lent itself to the case study approach despite the fact that one could employ a narrative research. Narrative research is the study of how human beings experience the world, and narrative researchers collect these stories and write narratives of experience (Gudmundsdottir, 2001). My hesitancy on the use of the narrative research methodology stemmed from the observation by Connelly and Clandinin, (2000) that the approach is both the phenomenon and the method, a postulation that, according to Moen (2006, p.57) some researchers “might find rather confusing and overwhelming.”

Creswell (2007, p. 73) explains that a case study “involves the study of an issue explored through one or more cases within a bounded system.” It is situated in temporal, geographical, organisational, institutional and other contexts that enable boundaries to be drawn around the case (Hitchcock & Hughes, 1995; Cohen et al., 2010). The issue explored in this study was the MLI of 14 high school learners who participated in the ‘bounded system’ of three SANCP-run after school mathematics clubs in primary school in Makhanda. The cases are discussed in detail below (see 4.6).

The qualitative case study approach provided me with detailed narrative descriptions of the given context and setting to help enable deeper understanding of the phenomenon of MLI (McMillan & Schumacher, 2001; Best & Kahn, 2006). The use of the interpretive paradigm in

this case study afforded rich data and ‘thick descriptions’ of participants’ lived experiences (Cohen et al., 2010; Teddlie & Tashakkori, 2009).

### **4.3 RESEARCH QUESTIONS**

The purpose of this study is to explore the MLIs of high school learners who participated in after school mathematics clubs in primary school. The overarching aim is to ascertain how their participation in after school mathematics clubs features (or does not feature) in the construction of their current mathematics identities and practices.

#### **4.3.1 Main research question**

What are the MLIs of high school learners who participated in after school mathematics clubs in primary school?

#### **4.3.2 Research sub-questions**

1. What are the key themes in learners’ stories of their current mathematical participation?
2. How do learners’ stories of their mathematics learning trajectories from their past participation and in relation to their imagined future participation feature in their present mathematics participation?
3. How does their participation in the after school clubs feature (if at all) in their mathematical identities?

### **4.4 SELECTING LEARNERS WHO PARTICIPATED IN MATHEMATICS CLUBS RUN BY SANCP**

The cohort of learners that participated in my study was drawn from three after school mathematics clubs hosted for at least two years by three primary schools in Makhandha, beginning in 2012 and 2013. The schools concerned fell into three different quintiles, as shown in Table 4.1, below.

Makhandha is a small town in the Eastern Cape province of South Africa. The majority of its population is unemployed and relies on national social grants for survival. Levels of education are low, with 42% of the population having only primary schooling or less (Makana IDP, 2005).

Although North-End Primary school (pseudonym) is located on the affluent side of town, it was noted that none of the learners who participated in the clubs resided anywhere near the school. They all came from the high-density townships in the east. The other two primary

schools, Mountview (pseudonym) and S. Msholozzi (pseudonym) are in close proximity to the townships, but in different quintiles. High-density suburbs (townships) in South Africa are poorly serviced, with limited commercial activities and widespread poverty (Shackleton, Hebinck, Kaoma, Chishaleshale et al., 2014). Table 4.1, below, displays specific information about each of the three clubs.

Table. 4.1 Primary schools that hosted SANCP after school clubs

| Club         | Quintile | Learners | Grade Club Began | Grade Club Ended | Year Club Began | Year Club Ended |
|--------------|----------|----------|------------------|------------------|-----------------|-----------------|
| North-End    | 5        | 7        | 3                | 4                | 2012            | 2013            |
| Mountview    | 4        | 10       | 3                | 4                | 2012            | 2013            |
| S. Msholozzi | 3        | 9        | 3                | 7                | 2013            | 2017            |

#### 4.4.1 The atmosphere of freedom in the clubs

I described the ethos of the after school mathematics clubs in detail in Chapter 2 (see 2.5). Graven (2011, p. 8-9) conceptualises these after school mathematics clubs as

extra-curricular clubs focused on developing a supportive learning community where learners' active mathematical participation, engagement and sense making are the focus. Individual, pair and small group interactions with mentors are the dominant practices with few whole class interactions.

The clubs allow for greater learner choice of activity. This freedom is conducive to productive learning since it grants learners more autonomy in their learning. This is in line with Gay's (2010) admonition that teachers must allow learners to be the experts of their own lives.

The atmosphere of freedom in the clubs nurtures learner numeracy proficiency by running learner-directed and learner-oriented mathematics activities as well as creating an ethos of 'mathematics is fun' (SANC, 2013). The atmosphere also allows the club facilitators to intentionally focus on the construction of positive participatory mathematical identities at the expense of covering the range of skills and knowledge required to 'get through' the Curriculum, or keep up with the other classes and work required for common assessments (Graven & Stott, 2012). The primary objective of the mathematics clubs was to present Mathematics as fun and a subject to be enjoyed.

When I interacted and interviewed the learners in 2019, they were in Grades 9 and 10 and enrolled at three high schools in Makhanda, as shown in Table 4.2, below. All names are pseudonyms.

Table 4.2 High schools where learners are enrolled

| High School | Quintile | Number of Learners |
|-------------|----------|--------------------|
| Vuyani      | 5        | 4                  |
| Mtambo      | 3        | 6                  |
| Sikelela    | 3        | 7                  |

#### 4.5 SAMPLING METHOD

To address the goals of this study, purposive sampling was used to select the participants. In purposive sampling, the researcher chooses participants who have the potential to offer insights into the questions posed or to help develop theory (Cohen et al., 2010; Creswell, 2007; Strauss & Corbin, 1990). Purposive sampling enabled me to elicit the richest and most in-depth information from participants who were the most relevant to the purpose of the study (Best & Kahn, 2006; Pattern, 1990). This sampling method responds to Cohen et al.'s (2010) caution that there is little benefit to be derived from using a random sampling method when most of the random sample may be largely ignorant of particular issues or unable to comment on matters of interest to the researcher. Polkinghorne (2005) notes that, when selecting participants for a study, researchers can select participants from a particular sub-group whose experiences are expected to be somewhat alike in order to describe the experiences of that sub-group in depth. To clarify, participants were purposively sampled based on their involvement in the mathematics clubs. Invitations were sent to all past club learners and all volunteers were included in the study.

The first step in selecting participants was to approach the three primary schools that hosted the clubs and ascertain where the learners who participated in them were enrolled for high school education. The project manager of the SANCP programme and I approached the principals of the three high schools concerned (Mrs Shaye from Mtambo, Mrs Schultz from Sikelela and Mr Middleton from Vuyani) [pseudonyms] and explained my research project to them before asking for permission to talk to their mathematics teachers and the identified learners.

We invited all 26 high school learners who were involved in the three after school mathematics clubs in primary school to a mathematics enrichment fun day. This fun mathematics day was part of the SANCP's follow up and continued support of club learners (it was organised by the SANCP project manager) but also provided an opportune space for inviting learners to participate in my research. Although SANCP had invited all the learners, some failed to attend. Table 4.3, below, shows the number of participants who were invited from the three after school



mathematics clubs to the two mathematics fun days and their subsequent attendance. All names are pseudonyms. from a particular sub-group whose experiences are expected to be somewhat alike in order to describe the experiences of that sub-group in depth.

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Table 4.3 Attendance at the first mathematics fun day (18-05-19)

| <b>Name of Club</b> | <b>Number Invited</b> | <b>Number Attended</b> | <b>Current Grade</b> |
|---------------------|-----------------------|------------------------|----------------------|
| North-End           | 7                     | 2                      | 10                   |
| Mountview           | 10                    | 7                      | 10                   |
| S. Msholozzi        | 9                     | 6                      | 9                    |
| <b>Total</b>        | <b>26</b>             | <b>15</b>              |                      |

Table 4.4 Attendance at the second mathematics fun day (19-10-19)

| <b>Name of Club</b> | <b>Number Invited</b> | <b>Number Attended</b> | <b>Current Grade</b> |
|---------------------|-----------------------|------------------------|----------------------|
| North-End           | 7                     | 3                      | 10                   |
| Mountview           | 10                    | 7                      | 10                   |
| S. Msholozzi        | 9                     | 7                      | 9                    |
| <b>Total</b>        | <b>26</b>             | <b>17</b>              |                      |

## 4.6 PARTICIPANTS

Of the 26 high school learners who participated in the three after school mathematics clubs and who were invited to the first mathematics enrichment fun day, fifteen attended and subsequently wrote their narrative stories. When we called for another mathematics enrichment fun day five months later, one of these fifteen learners did not attend, thus I have included for analysis only the 14 complete narratives (i.e. both the written and spoken stories are available).

Three learners from the Grade 10 cohort chose to pursue Mathematical Literacy, while seven continued with Mathematics post the compulsory schooling stage of Grade 9. Five learners from Grade 9 indicated that they were going to choose Mathematics, and two Mathematical Literacy. The learners' choices are presented in Table 4.5 below.

Table 4.5 Learners' post-compulsory schooling choices

| Name      | Gender | School   | Grade | Subject Chosen        |
|-----------|--------|----------|-------|-----------------------|
| Cebisa    | F      | Vuyani   | 10    | Mathematics           |
| Lulu      | F      | Vuyani   | 10    | Mathematics           |
| Aphiwe    | M      | Sikelela | 10    | Mathematical Literacy |
| Sisipho   | F      | Sikelela | 10    | Mathematical Literacy |
| Ayabonga  | M      | Sikelela | 10    | Mathematics           |
| Nkosi     | M      | Sikelela | 10    | Mathematics           |
| Lindelwa  | F      | Sikelela | 9     | Mathematics           |
| Zimkhitha | F      | Sikelela | 9     | Mathematical Literacy |
| Anathi    | F      | Sikelela | 10    | Mathematics           |
| Akhona    | F      | Mtambo   | 10    | Mathematics           |
| Funeka    | F      | Mtambo   | 9     | Mathematics           |
| Esihle    | F      | Mtambo   | 9     | Mathematics           |
| Khethiwe  | F      | Mtambo   | 9     | Mathematics           |
| Lisa      | F      | Mtambo   | 9     | Mathematics           |

In total, 17 learners wrote their mathematics stories. Fifteen stories were written on the first mathematics fun day (18 May 2019) and two stories on the second mathematics fun day (19 October 2019). On the latter day I interviewed the 14 learners who had written their stories on the first mathematics fun day. I went on to use the 14 stories accompanied by interviews for in-depth data analysis. Although including more participants would have been ideal, working

with stories from 14 individuals allowed for both the in-depth analysis needed to understand their perspectives and the breadth needed to comprehend their mathematics identities.

The initial intention was to invite the club facilitators and the current Mathematics teachers of the learners to participate in the study. I wanted facilitators to write narrative accounts of the learners, focusing on their participation and attitudes in all the club activities for the period that they worked with them in the after school mathematics clubs. It was hoped that the current Mathematics teachers of the selected learners would answer open-ended questions in interactive interview sessions give an account from their perspective of the learners' conduct and attitudes in Mathematics lessons. However due to the Covid-19 global pandemic lockdown protocols, I could not get narrative accounts of learners from their club facilitators, nor could I manage to interview the learners' current high school Mathematics teachers.

## **4.7 METHODS OF DATA COLLECTION**

Two data generation methods were employed: learners' narratives and interactive interviews with open-ended questions. This is in line with Cohen et al.'s (2010, p. 289) observation that "case studies recognise and accept that there are many variables operating in a single case, and, hence, to catch the implications of these variables usually requires more than one tool for data collection and many sources of evidence." These methods afforded sufficient dialogue with the participants in order collaboratively to construct a meaningful reality.

### **4.7.1 Narratives**

Kaasila, Hannula, Laine, and Pehkonen, (2007, p. 112) define a narrative as a "story that tells a sequence of events that are significant for the narrator and his or her audience." Moen (2006, p. 60) adds that, when narratives are "looked on within the framework of sociocultural theory, we have to remember the interlinking between the individual and her or his context. As individuals are telling their stories, they are not isolated and independent of their context."

In their stories, the learners foregrounded their various landscapes of practice, which included primary and secondary school classes as well as participation in after school mathematics clubs. Some learners referenced their homes and peer groups as contexts that helped to shape their mathematical identities. As a matter of fact, Wertsch (1991) reiterates that it is imperative to remember that individual learners are irreducibly connected to their social, cultural and institutional settings. Autobiographical stories, therefore, capture both the individual and the

context (Moen, 2006) to provide rich or ‘thick’ descriptions of learners (Geertz, 1973, in Miles & Huberman, 1986; Denzin, 1989) as they traverse the different landscapes of practice.

These stories include a temporal ordering of events and an effort to make something out of the events: to render or signify the experience of persons-in-flux in a personally and culturally coherent, plausible manner (Sandelowski, 1991). This understanding of personal stories follows Polkinghorne’s (1988, p. 1) thinking that stories are “the primary form by which human experience is made meaningful.” It makes sense to maintain that the stories we tell are such because they reflect the stories we are (Randall, 1995). In addition, “stories have particular features. Stories instruct, they reveal, they inform in special ways.... People have also been known to make diagrams that display relationships that otherwise would be impossible to grasp” (Eisner, 1997, p. 175).

In this study I adopted Sfard and Prusak’s (2005b, p. 16) view that a narrative is “significant if any change in it is likely to affect the storyteller’s feelings about the identified person.” They claim that “the most significant stories are often those that imply one’s memberships in, or exclusions from, various communities” (p. 16). According to Bamberg and Georgakopoulou, (2008), stories are privileged forms or systems for making sense of self by bringing the coordinates of time, space, and personhood into a unitary frame. The sources behind these representations can be made empirically visible for further analytical scrutiny in the form of identity analysis.

#### **4.7.2 Narratives as a means for generating data**

To regard personal narratives as a source of data implies a general approach that views individuals within their social environments as actively conferring meaning onto objects in the world, including others and themselves (Bamberg, 2010). Narratives are powerful research tools because they carry traces of human lives that help us to describe, understand and even explain important aspects of the world (Andrews, Squire, & Tamboukou, 2013). They are useful as a source of data because individuals often make sense of the world and their place in it through narratives (Feldman, Sköldberg, Brown, & Horner, 2004).

Cohen et al. (2010, p. 584) underscore that stories have “facts, themes, actors, a sequence, agency, coherence, situatedness and a sense of audience, all of which are elements of true discourse....” Sequencing in narrative is important as its structure reveals what is significant to people about various practices, ideas, places, and symbols (Young, 1996). Accordingly, Barthes (cited in Feldman et al., 2004) extols narrative’s ubiquity, noting that all classes, all

human groups, have their narratives, and that narrative is international, trans historical, and transcultural: it is simply there, like life itself. The concept of narrative was used by Graven and Buytenhuys (2011) to ask Mathematical Literacy learners to tell their mathematics stories from Grades 1-12, and how their participation in their Mathematical Literacy classroom community enabled the transformation of mathematical identities.

Generally speaking, through the retelling of events in narrative form, the storyteller not only illustrates his or her version of the action but also provides an interpretation or evaluative commentary on the subject under discussion (Feldman et al., 2004). Participants in this study wrote narratives of their trajectories from the time they commenced Grade 1 to their current Grades 9 or 10. Sequencing within the stories thus started from the time they entered school for the first time and progressed, highlighting important episodes and low moments along the way.

The prompt that I used to gather learners' stories was this (see Appendix A):

Write your story of yourself as a mathematics learner from Grade 1 to now.

You can tell this story in any way you like – there is no right or wrong way to write this.

You can write in any language that you are comfortable writing in – you can even mix languages!

If you don't know how to start, close your eyes for a moment and picture yourself as a Grade 1 learning maths . . . Imagine yourself in Intermediate Phase learning maths . . . Think of yourself when you started learning high school maths . . . and think about yourself as a mathematics learner now.

Now write your story. . .

#### **4.7.3 Mathematics enrichment fun day**

The mathematics enrichment fun day is an ongoing SANCP activity to which former after school mathematics club members are invited. Learners are exposed to a variety of mathematics activities and competitions where they are expected to work in pairs or small groups. The SANCP mathematics enrichment fun day provided me with an ideal occasion for data collection. At the gathering I was introduced by SANCP Chair Professor Graven to the fifteen learners present as a PhD scholar. I was given the opportunity to explain the focus and objectives of my study. This was in line with Fine and Sandstrom's (1988, in Cohen et al., 2010) advice that researchers provide participants with a credible and meaningful explanation of their research intentions. I then invited learners who were willing to take part in the research to write detailed mathematics stories covering the years from Grade 1 to the present. I was

interested to see whether learners would talk about their after school mathematics club experiences in the stories on their own without any direct prompts.

To make learners more comfortable and to allow them to put as much thought as they wanted into their stories I did not impose a time limit on their story writing. I also explained that I was not at all worried about grammatical errors, and those who preferred to write in their home language were encouraged to do so. They were even free to use more than one language in their stories. Despite this, the learners all wrote their stories in English, which is the medium of instruction in their high schools. Finally, the learners were asked to include drawings, slogans, mottos and any creative artwork that they felt would help them explain their mathematics stories.

Since this study sought to understand and explore MLIs and whether participation in the mathematics clubs would feature in these stories, I followed up five months later with interactive interviews, seeing whether their stories had evolved with further thought or remained the same.

#### **4.7.4 Interactive interviews**

To be able to answer the research questions about the MLIs of high school learners who participated in after school mathematics clubs in primary school, I found open-ended, semi-structured, interactive interviews to be the most suitable complementary data gathering method. Interviewing is one of the data generation methods most commonly used in qualitative studies in education research (Merriam, 1998), and interactive interviews, sometimes referred to as narrative interviews, are mainly used in qualitative interactive studies (Connelly & Clandinin, 1990; Corbin & Morse, 2003; Neuman, 2009). Interactive interviews are defined as shared experiences in which researchers and interviewees come together to create a context of conversational intimacy in which participants feel comfortable narrating their stories (Corbin & Morse, 2003). They are mainly used in narrative inquiry research and focus on the participant's lived experience (Clandinin & Connelly, 1994; Clandinin, 2006).

Generally speaking, interviews are used to elicit specific information from the respondent that allows the interviewer to access their perspective (Best & Kahn, 2006; Neuman, 2009). In other words, if successful, they enable the researcher to see the world through the eyes of the participant (Maree, 2008). Interviews are not merely about "the giving and receiving of information but at least as much about speaking identities into being, solidifying them and constantly reconstituting them through the stories we tell ourselves and each other" (Epstein &

Johnson, 1998, p. 105). In this research, I used follow-up interactive interviews to give participants the opportunity to confirm or reconsider the stories that they had written five months earlier. I asked about gaps in their stories and their reasons for responding as they did, encouraging them to delve deeper into their motivations for responses.

It must be conceded that interviews can give undue prominence to the interviewer, since s/he can dominate the interview process and silence the voice of the interviewee. Interactive interviews seek to reverse such hierarchical interviewing relations, with participants retaining considerable control over the course of the interview and enjoying the time and space to tell their story to the interviewer (Connelly & Clandinin, 1990; Corbin & Morse 2003).

I thus used semi-structured interactive interviews (see Appendix B) to allow room for revealing the feelings and perspectives of individuals, a result for which a structured interview schedule would not be suitable. Open-ended questions suit interactive interviews as they encourage cooperation, help establish rapport, and provide opportunities for participants to construct their stories (Corbin & Morse, 2003; Cohen et al., 2010). In this study, interactive interviews attempted in their construction to privilege the learners' voices and reduce the interviewer's influence, however the identities are unavoidably jointly created.

The interactive interview approach enabled me to understand how the learners experienced their lifeworld (Fontana & Frey, 1994) and how they made sense of what was happening to them, from the time they commenced primary school to their present experience of high school. The questions were directed at their first-hand experiences and convictions about how they had traversed the initially dissonant terrain of mathematics (Clandinin & Connelly, 1994).

All the interviews were individually audio-recorded in a quiet room with no disturbances and each interview lasted between 3 and 8 minutes. The learners were interviewed on a Saturday when they were attending the second mathematics enrichment day organised by SANCP for two cohorts of learners who had participated in after school mathematics clubs. The interviews therefore did not interfere with learners' schoolwork.

As the learners narrated their stories of participation, I gleaned information about changes in their mathematics identity stories (Sfard & Prusak, 2005b) and their learning trajectories (Wenger, 1998). This enabled the study to address the study's overarching research question and research sub-questions. As I interviewed each learner individually, I observed their body language, a vital indicator of participants' feelings. The interview schedule appears in Appendix B.

## **4.8 ETHICAL CONSIDERATIONS**

Although Foucault (1972) suggests that where there is power, there is also resistance, I must confess that I did not come across any resistance from the participants or school authorities that I worked with in this study. The only challenge that I encountered and which was beyond my control was the effect of delays and difficulties in completing the newly introduced Ethics Clearance application form at Rhodes University. However, the words of Oakley (as cited in Sayer, 1992, p. 256) helped me to surmount the challenge and practice patience as I waited for the clearance:

like any activity, research is a social process; and adopting an academic conception does not render the process innocent or ethically neutral: on the contrary, the belief that it does may permit insensitivity and political naivety. While these general warnings about ethical problems must be heeded, actual decisions must be made in the light of an evaluation of the particular politics (including one's own 'personal politics') of the situation under study, with all its conflicting interests and imbalances of power....

Ethical considerations relate to beliefs regarding what is wrong and what is right from a moral perspective in the conduct of research (McMillan & Schumacher, 2001). In other words, research ethics are concerned with how researchers comply with acceptable research norms, morals, standards and principles. According to Punch (2009), approaching people for data generation requires the researcher to be ethical. One should consider all the procedures in the research that may violate the rights of the participants. In this regard, most ethical issues in research fall into one of four categories: protection from harm, informed consent, right to privacy, and honesty with professional colleagues (Leedy & Ormrod, 2010). The two ethical considerations that were therefore important to this study were ensuring the informed consent of participants and their right to privacy, and these are discussed in detail below.

### **4.8.1 Procedural ethics**

Ethical clearance for this PhD research study was obtained after a long, arduous, exhausting and sometimes frustrating process. In the end the Rhodes University Ethical Standards Committee: Human Ethics (RUESC) granted me Provisional approval research clearance pending gatekeeper permission by the Eastern Cape Department of Education (ECDoE): Permission to undertake a doctoral research study. Full approval from RUESC was granted on submission of the permission from the ECDoE. This clearance is annually renewable, and the most recent renewal is included as Appendices C and D.

The learners in this study were minors (<16 years of age), so were considered potentially vulnerable. Greig and Taylor (1999) point out that non-therapeutic research should only be



conducted with learners where there is negligible risk and where the informed consent of gatekeepers has been obtained in advance, including regarding how data will be stored (e.g. ICT-related issues), or destroyed upon completion of the research (e.g. confidential data or audio recordings). The data collected comprised written narratives from learners and follow up interactive interviews, so to minimise vulnerability and risk among learners I used pseudonyms. I carried out the interviews during times that did not affect the schooling of the learners. Interactive interview transcriptions and stories from learners were kept on a secure hard drive dedicated to the research project.

After receiving the requisite clearance letters from RUESC and ECDoE, my supervisor and I approached the three Principals of the schools where the participants with whom I intended to work were enrolled. We requested to meet the selected learners and their current mathematics teachers and gave the learners invitation letters to attend the Mathematics Fun Day at Rhodes University. My supervisor outlined all the logistical issues for the Maths Fun Day to the learners and gave learners letters of consent that had to be signed by parents or guardians.

#### **4.8.2 Ethics in process**

Having obtained all the necessary ethical clearances to proceed, the next stage in the research process consisted of the contact sessions with participants. On the two contact sessions with learners I was careful to treat all participants fairly and carried out both the narrative writing session and the follow-up interview session in an open room that enhanced privacy but did not compromise the safety of the learners. In addition, on the second and final contact session of follow-up interactive interviews, I reminded each participant of their right to withdraw from the research study at any stage of the research process.

Both the narrative writing session and the follow-up interview session proceeded smoothly, and I managed to generate ‘thick descriptions’ (Geertz, 1973, in Miles & Huberman, 1986, p. 10) of participants’ journeys from the time they started primary school to their current high school experience.

#### **4.8.3 Informed consent and protection from harm**

According to Diener and Crandall (1978), cited in Cohen et al. (2010, p. 78), informed consent refers to the “procedures in which individuals choose whether to participate in an investigation after being informed of facts that would be likely to influence their decisions.” Informed consent is the cornerstone of ethical behaviour, as it respects the right of individuals to exert

control over their lives and to take decisions for themselves (Cohen et al., 2010). To comply with the University's research ethics codes, guidelines, protocols and practices, my PhD research proposal, with ethical deliberations, was presented on 17 January 2019 and approved by the Education Higher Degrees Committee at the end of January 2019. After getting clearance to carry out my study from Rhodes University in conjunction with the Department of Education in the Eastern Cape province, I took letters to the Principals of the high schools where the learners concerned were enrolled, asking for permission to talk to them.

The next step was to explain the aim of my research to learners and then invite their consent to participate. The principle of informed consent arises from the subject's right to freedom and self-determination (Cohen et al., 2010). Being free is a condition of living in a democracy, and when restrictions and limitations are placed on that freedom they must be justified and consented to. Flick (2011) confirms that research studies should involve only people who have been informed about being studied and are participating voluntarily. Consent therefore protects and respects the right of self-determination and places some of the responsibility on the participant should anything go wrong in the research. Learners were informed that they were free to exit the research project at any time if they felt they were not comfortable with continuing with it. This is line with the assertion of Frankfort-Nachmias and Nachmias (1992)'s assertion (in Cohen et al., 2010) that, as part of the right to self- determination, subjects have the right to refuse to take part, or to withdraw once the research has begun. Learners were given letters to take home to seek consent from their parents or guardians. Data generation only commenced after all the necessary permissions had been obtained.

As the researcher, I am aware of the ethical principles of autonomy, non-maleficence and beneficence (Bertram & Christiansen, 2014; Cohen et al., 2010), and adhered to them with the sole aim of minimising harm to participants (Mills, 2003) while at the same time maximising the benefits of the research. Learners were made aware of the benefits of the research to education in South Africa at large. They were informed that their real names would not be used, and that instead pseudonyms would be adopted for each learner, school and club coordinator.

#### **4.8.4 Right to privacy, anonymity and confidentiality**

Another ethical consideration that informed this study was the right to privacy, which entails avoiding infringing the personal freedoms of participants and keeping sensitive personal information about them in confidence (Leedy & Ormrod, 2010; Litchman, 2010; Cohen et al., 2011). The right to privacy endows the individual with the freedom to decide for themselves

when and where, in what circumstances and to what extent their personal attitudes, opinions, habits, eccentricities, doubts and fears are to be communicated to or withheld from others (Cohen et al., 2011). People who participate in a research project normally have the expectation that their privacy will be guaranteed. To ensure this, the participant list was not publicly available; learners could tell people that they were participating or not at their own discretion. McMillan and Schumacher (2001) and Neuman (2009) suggest that guaranteeing privacy, anonymity and confidentiality means that access to participants' responses, behaviour and information is restricted to the researcher and kept secret from the public. To ensure non-violation of the right to privacy, I provided participants with a private and secure space in which to share confidential information during the follow-up interactive interviews, which were conducted on a one-on-one basis (see also Frankfort-Nachmias & Nachmias, 1992). It was not possible for anyone other than the participant and myself to hear the content of the interviews, and the transcriptions were done by a translator based in the United Kingdom with no knowledge of the participants – thus further ensuring privacy. Similarly, when writing their stories, participants could choose any space within the courtyard and surrounding buildings to write, so that their words would not be visible to any other participants or facilitators other than the myself and my supervisor. I also applied the principle of anonymity, whereby the information provided by participants would in no way reveal their identity. Identifying aspects of the narratives were redacted from the original documents and pseudonyms used to ensure anonymity of the participants and the teachers and schools mentioned by name.

Access to the written stories and interview transcripts was restricted to the myself and my supervisors and kept hidden from public scrutiny. The learners' stories and interview transcripts are being kept under lock and key for a period of five years, after which they will be destroyed. I made use of some of the ways of achieving anonymity listed by Frankfort-Nachmias and Nachmias (1992), such as the use of aliases and codes for identifying people (to keep the information on individuals separate from access to them), and the maintenance of password-protected files. In summary, participation was private and confidential, and data was anonymised.

#### **4.9 VALIDITY AND RELIABILITY OF DATA**

According to Cohen et al. (2010), the validity of any life history lies in its ability to represent the informant's subjective reality, that is to say, his/her construal or definition of the situation. This implies that in qualitative research, the issue of validity might be addressed through the

honesty, depth, richness and scope of the data obtained, the extent of triangulation and the disinterestedness or objectivity of the researcher (Winter, 2000). To enhance the interpretive validity of this study, I used direct excerpts from learners' stories and interviews so that the meanings of events and the intentions of the subjects were not distorted (Maxwell, 1992).

The validity and reliability of the data were enhanced by using mixed methods in data collection. The use of multiple data sources is often seen as supporting a case study's claim to validity (Swain, 2017). The related process of triangulation was employed to compare and cross-check data from participant stories and interactive interviews. The concept of triangulation may be defined as the use of two or more methods of data collection in the study of some aspect of human behaviour (Cohen et al., 2010). It is the process of corroborating evidence from different individuals, types of data or methods of data collection in descriptions and themes in qualitative research (Creswell, 2012). Cohen et al. (2010) explain that triangulation techniques in the social sciences attempt to map out, or explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint. My use of two sources of data thus increased the overall credibility and validity of the study.

According to McMillan and Schumacher (2001), the use of mechanically recorded data such as audio recordings also enhances the validity and reliability of research findings. All the learner interactive interviews were transcribed, and I thoroughly revised all the transcriptions by careful cross-checking with the audio. My supervisors checked on whether my interpretations resonated with their readings of the data and were therefore the basis for reasonable inferences. They also cross-checked the interview transcriptions.

To provide readers with the opportunity to assess the validity of my interpretation of data, I used direct excerpts from the participants' interviews and stories. According to McMillan and Schumacher (2001), verbatim accounts or direct quotations enhance data corroboration and help the study provide thick description of events and illustrate participant' experiences and meaning-making.

#### **4.10 DATA ANALYSIS**

Data analysis starts even before the researcher begins a research project, when the researcher grapples with defining what to look for in the data (Bernard & Ryan, 2010). According to Bloomberg and Volpe (2008, p. 127), data analysis refers to "making sense of large amounts of data collected, and includes reducing raw data, identifying what is significant and constructing a framework for communicating the essence of what the data reveals." Cohen et

al. (2010) observe that qualitative data analysis involves organising, accounting for and explaining the data; in short, making sense of the data in terms of the participants' definitions of the situation by noting patterns, themes, categories and regularities.

The goal of this study was to understand MLIs of learners who participated in after school mathematics clubs in Makhanda. The learners were exposed to different teaching methodologies in traditional classrooms and the after school mathematics clubs. I analysed the narrative stories and interactive interviews using Wenger's (1998) modes of belonging framework. I also used the three strands adopted from Solomon's (2009) 'mathematics as a social and cultural activity' framework as supplementary tools to make my analysis clearer. The two frameworks are discussed in detail, above, in Chapter 3, Section 3.8.

I began my data analysis by typing all the handwritten autobiographical stories and transcribing interactive interviews. Later on, I coded and categorised data into manageable patterns or themes to help make sense of it. Data was then analysed using the modes of belonging framework and the supplementary tools from Solomon. These are briefly discussed below.

#### **4.11 PROCEDURES OF DATA ANALYSIS**

The most important inputs into data analysis and interpretation in this study were the research questions, the propositions from Solomon's (2009) social and cultural activity category and the modes of belonging analytical framework (Wenger, 1998). Initially, in the analysis, I focused on reading and understanding the data itself, coding it sentence by sentence in terms of the strands in Solomon's (2009) social and cultural activity category and Wenger's modes of belonging framework. I later built up more abstract conceptualisations (Radovic et al., 2018). In the words of Thomas and Harden (2008), the analysis progressed from line-by-line coding towards descriptive and analytical coding, and then to my own interpretation of the narrative data (inductive data analysis).

The data analysis proceeded in two main phases; one that aimed to understand the personal mathematics identities of participants in their narrative stories and the other that focused on corroborating learners' mathematical identities by exploring the themes in their interactive interviews, which were carried out five months after they wrote their stories.

Several steps were taken in the process of data analysis. The first two steps were in line with the exhortations of Taylor-Powell and Renner (2003) and Blanche, Durrheim, & Painter (2006) to read all the data several times in order to become familiar with it.

1. I typed all the learners' stories verbatim and read the stories several times to familiarise myself with their content and terminology.
2. I had all the interactive interviews professionally transcribed and read those several times.
3. I listened to the interviews and checked the correctness of the transcriptions.
4. I delineated all relevant utterances from the interviews and stories as a phrase, sentence or group of consecutive sentences that conveyed a single idea; and I coded each utterance several times under the corresponding modes of belonging and Solomon's (2009) frameworks. The coding rules are discussed in detail in Chapter 5.
5. My supervisor checked my coding to establish whether I had reached data saturation in the coding and had coded coherently.
6. I identified emerging themes on learner identities from the learners' stories and interactive interviews (inductive data analysis).

## **4.12 CODING RULES FOR THE MODES OF BELONGING**

Sfard and Prusak (2005a, p. 44) argue that “the most significant stories are often those that imply one's memberships in, or exclusions from, various communities.” Learners in this study have been members of various learning communities from the time they started primary school. For this reason, I chose to employ Wenger's (1998) three modes of belonging – imagination, engagement and alignment – to analyse their MLIs in the stories they tell, spanning a period of more than eight years. As Fenton-O'Creevy, Dimitriadis and Scobie (2015) observe, MLIs are not just an individual attribute but are negotiated anew in each learning community in which learners participate. This echoes Weick's (1995) argument that as learners construct their identity, they are also enacting the environment around them. Since my study uses the three modes of belonging as analytical tools to explore learners' mathematical identities from when they started school, through their passing through different learning communities to their current Grade 9 and 10 levels, I briefly explain these modes of belonging, together with the concepts of identification and negotiability.

### **4.12.1 Engagement**

Engagement is described as active involvement in mutual processes of negotiation of meaning and it shapes experiences of who we are and how we are seen by others in society (Wenger, 1998). Put in simpler terms, engagement is the most immediate relation to a practice where learners engage in various activities, do certain things, work alone or together, interact, use and produce artefacts (Wenger, 2000; Wenger-Trayner & Wenger-Trayner, 2015). For the purposes of this study, my indicator of engagement is the learners' most immediate successful involvement in mathematical group activities or mention of how they experienced challenges that limited mathematical practices.

Engagement involves mutuality in working on issues, reflecting, and debating in the various learning communities that learners pass through. It entails direct experience of regimes of competence, whether learners' engagement is a visit or a lifetime commitment, whether the result is an experience of competence or incompetence and whether they develop an identity of participation or non-participation (Wenger-Trayner & Wenger-Trayner, 2015). I use this mode to glean participants' views on engagement in individual or group mathematical work, or regarding how they experienced challenges that limited their engagement in mathematical group work (Oppland-Cordell & Martin, 2015).

#### **4.12.2 Alignment**

Wenger (1998) defines alignment as the way we coordinate our energy and activities to fit within broader structures and contribute to broader enterprises. Goodnough (2010) asserts that alignment involves establishing common ground and defining broad visions through which members communicate and through which they also belong to a practice. In this study my indicator for alignment is the learners' compliance with various rules and regulations in learning mathematics, failure of which may result in learners having limited engagement opportunities.

In this study I will therefore consider a phrase, sentence or group of consecutive sentences from stories or interactive interviews that describe learners' involvement in mathematical activities as modes of belonging (see examples in Table. 5.1). Learners' engagement is rarely effective in practice without alignment with the context, coordination of activities, and implementation of regulations and intentions (Wenger-Trayner & Wenger-Trayner, 2015). Under the heading of alignment, I look for utterances that explain learners' responses to relevant instructions and regulations. I present examples of learners' utterances from stories and interviews that fall under the different modes of belonging in Table 4.5, below.

#### **4.12.3 Imagination**

Imagination "refers to a process of expanding our self by transcending our time and space and creating new images of the world and ourselves" (Wenger, 1998 p. 176). Imagination also focuses on self-awareness and reflection in relation to understanding others and their actions, connecting to new trajectories and locating ourselves in landscapes of practice, creating new artefacts and processes, exploring new ways of doing things, and seeing new identities for ourselves (Goodnough, 2010).

Imagination allows learners to conceive of their participation in landscapes of practice and envision possible futures involving the application of mathematics in real life (Pausigere, 2014). In terms of this mode, I expect learners' stories to reflect images of their past, present, and future in mathematics education.

#### 4.12.4 Identification

Identification is the action of constructing multiple identities to bring out the continuously shifting possibilities arising from changes in discourse when individuals meet in a social realm (Stentoft & Valero, 2009). The process of identification, adds Wenger (1998), can be both positive and negative in the sense that it incorporates relations that mould what we are and what we are not, what we enjoy and what we fear, and it engenders identities of both participation and non-participation.

It is pertinent to note that some learners will be privileged by having adequate negotiability skills to participate meaningfully, while others will not be able to participate meaningfully.

#### 4.12.5 Negotiability

The process of negotiability refers to the ability, facility, and legitimacy to contribute to, take responsibility for, and shape the meanings that matter within social configurations (Wenger, 1998). Negotiability represents the degree to which learners take control over the meanings of activities in which they are invested or participating. It enables learners to make meanings applicable to new circumstances, and to enlist the collaboration of others in the group to embrace the new meanings (Wenger, 1998).

The Table 4.6, below, shows how modes of belonging are employed to present learner stories under the category headings of identification and negotiability in relation to their participation.

Table 4.6: The modes of belonging and the concepts of identification and negotiability

|                   | IDENTIFICATION                                                       |                                                  | NEGOTIABILITY                           |                                                                                 |
|-------------------|----------------------------------------------------------------------|--------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------|
| Mode of belonging | Identities of participation                                          | Identities of non-participation                  | Identities of participation             | Identities of non-participation                                                 |
| Engagement        | Participation in the landscapes of mathematical practice with others | Experiencing challenges that limit participation | Having one's ideas adopted by the group | Marginalisation through having one's ideas ignored or made to feel disempowered |
| Example           | I was so active, and I would really                                  | ... I was really overwhelmed                     | Because I had a wonderful teacher       | Pure Maths is no child's play                                                   |



|             |                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                       |                                                                                                                                                       |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | look forward to Maths club every week ...(Atha s7)                                                                                                                                     | with the amount of difficulty as compared to primary (Atha s 10)                                                                                                                                                                                                                                                                  | who would clearly explain the work I could still bag some As of which encouraged me to choose Pure Maths (Atha s15)                                                                                                   | and is very challenging (Atha s17)                                                                                                                    |
| Imagination | Feeling enthralled by the various mathematical games/activities                                                                                                                        | Failure to get excited by the games/activities on offer                                                                                                                                                                                                                                                                           | Vicarious experience and perceiving self as having understanding of mathematical concepts worth sharing in landscapes of mathematical practice                                                                        | Assuming that fellow members in landscapes of mathematical practice have stronger ownership of mathematics concepts                                   |
| Example     | Maths started being a fun subject for me. I would feel very eager to have a maths period.... Every Math class I would look forward to what she was going to teach (Atha s19; s20; s23) | Then came grade seven where we got into deeper algebra. There were times when I would be so lost in class and even battle in assignments. And in grade seven algebra was a bit of a problem in some sections where there were algebraic fractions, there my interest in Maths was quiet very low due to that (Atha s14; s15; s16) | I then started High school in grade 8, I had a very loving and calm Maths teacher. I understood what was going on in class and I was very engaged. ... Maths started being a fun subject for me (Atha s17; s18; s19*) | So, in grade 10 Maths is not AS FUN as the lower grades since it is more challenging, developed and requires a lot knowledge and thinking. (Atha s32) |
| Alignment   | Pledging allegiance to the landscapes of mathematical practice by following norms and values (e.g. listening to others' contributions and                                              | Violating norms and values of landscapes of mathematical practice                                                                                                                                                                                                                                                                 | Coordinating enterprises across context to strengthen ownership of mathematics                                                                                                                                        | Copying someone's work without contributing or understanding                                                                                          |

|         | engaging with them)                                                                                               |                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                 |
|---------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Example | Maths in grade four went pretty well since I had a good foundation from my previous preparatory school (Atha s12) | Then came grade seven where we got into deeper algebra. And in grade seven algebra was a bit of a problem in some sections where there were algebraic fractions, there my interest in Maths was quite low due to that. (Atha s14*; s16) | She would show us solutions to the problems which when I saw, I would be like “Oh wow!”<br>... I would easily be able to apply concepts to given problems and be able to solve them.<br>I really enjoy Maths because I learn strategies and it stretches my brain and makes me able to tackle problems (Atha s24; s25; s34) | I had times where I didn’t fully understand some sections and that made me feel very miserable and not want to have Maths and not want Maths periods to happen and cause me to panic (Atha s31) |

Adapted from Wenger (1998) and Oppland-Cordell & Martin (2014)

#### 4.12.7 Using three of Solomon’s five strands in analysing data

As explained in Chapter 3, Section 3.8.3, although this study is not about learners’ beliefs in mathematics, but I do draw on three of five categories of stories about mathematics identified by Solomon (1999) in my analysis of the spoken and written narratives of the 14 learners.

After ‘immersing’ myself in both the written narratives and the interview transcripts from the 14 participants in the study, I decided to collapse two strands (‘narratives about oneself as a maths learner’ and ‘perception of self as a potential participant in maths’) into one (narratives about oneself as a maths learner) because data reading showed a blurred distinction of the two, this was likely due to the way I asked the participants to tell their mathematics story. Collapsing two strands into one is in line with Wellington’s (2015, p. 262) explanation that “researchers can look for *similar* (original emphasis) categories which could then perhaps be merged to form one new one”. If I had asked specific questions about the learners’ perception about themselves as potential participants in mathematics, I expect that I could have used the strands separately that I have collapsed, in data analysis.

#### 4.12.8 Stories about the nature of mathematics

This category covered all utterances in which learners described mathematics as a subject. Here I analysed learners' notions about the inherent features of mathematics as expressed in their stories and interactive interviews. I searched for moments in these stories and interviews when learners used specific adjectives, verbs, idioms and special phrases to capture the nature of mathematics.

The strand of stories about the nature of mathematics refers to the learners' stories and learners' interviews where they used specific adjectival phrases, idioms and special phrases to explicitly describe what mathematics means to them. In this study stories about the nature of mathematics refers to learners' preconceived perceptions gathered in social networks and their developed perceptions about mathematics.

#### **4.12.9 Stories about themselves as learners of mathematics**

I used this category to search for moments in the learners' narratives and interview transcriptions when they specifically described themselves as mathematics learners. I did this because "an individual's beliefs, in interaction with the context, shape the formation and prioritisation of goals" (Schoenfeld, *Powerful environments for promoting deep conceptual and strategic learning*, 2005, p. 41) in mathematics learning. A learner's narrative ultimately describes what s/he believes about herself or himself in regard to mathematics, which is her/his mathematical identity.

For the learners' stories about themselves as mathematics learners, I search for moments in the learner's narrative where he/she described himself specifically as a mathematics learner. According to Schoenfeld (2005, p. 41), "an individual's stories, in interaction with the context, shape the formation and prioritization of goals" in mathematics. In addition, a learner's perception of self as a potential participant in mathematics relates to the learner's discourse about how he perceives himself as a doer of mathematics (Martin, 2012). Under this strand I search for learners' descriptions of themselves in regard to mathematical practice and their discourse about their self-introspection as potential doers of mathematics.

#### **4.12.10 Stories about participation or engagement in mathematics activities**

Under the topic of engagement in mathematics, I looked at utterances that corresponded with the learner's participation in mathematical activities in their story, because a learner's behaviour when confronted with a task is determined more by their beliefs and personal experiences than by their knowledge of specific tasks (Philippou & Christou, 1998). Under this

rubric I also searched for occasions when the participants asked for assistance with assignments or homework, and when they discussed engagement in specific mathematics activities.

Table 4.7 extracts texts as a phrase, sentence or group of consecutive sentences from stories or interactive interviews that describe learners' involvement in mathematical activities under the three strands of the social and cultural activity categories.

Table 4.7 Solomon's (2009) social and cultural activity

|                 | <b>Narratives about stories about the nature of mathematics</b>                                         | <b>Narratives about stories about oneself as a mathematics learner</b>                                                                 | <b>Narratives about engagement in mathematics</b>                                                                   |
|-----------------|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Examples        | ...maths starting from grade 9 started being super difficult... (Nkosi. Written story)                  | ....I'm a slow learner... (Akhona. Written story)                                                                                      | So now I'm getting there with the hard work and effort I'm putting in my work. (Aphiwe. Written story)              |
| Reason for code | Learner describes the nature of mathematics                                                             | Learner's description of herself as a mathematics learner.                                                                             | Learner's description of her engagement in mathematical enterprise.                                                 |
| Examples        | First lessons for maths lit (Literacy) were great and I found it easy and fun. (Sisipho. Written story) | I began to love maths even more. (Akhona. Written story)                                                                               | Maths was a lot harder than before but I taught myself to work hard and practice every day. (Akhona. Written story) |
| Reason for code | Learner describes her feelings about mathematics                                                        | Learner's description of herself as a mathematics learner.                                                                             | Learner's description of her engagement in mathematical enterprise.                                                 |
| Examples        | ... I saw that maths is actually a fun subject to do and I was loving it. (Ayabonga. Written story).    | As I grew up I started to develop love for maths. (Nkosi. Written story)                                                               | I loved the maths club because we had maths tricks that we used while doing an activity. (Esihle. Written story)    |
| Reason for code | Learner's reflection about what mathematics means to him                                                | Learner's description of herself as a mathematics learner.                                                                             | Learner's description of her engagement in mathematical enterprise.                                                 |
| Examples        | Pure Maths is no child's play and is very challenging. (Cebisa. Written story).                         | I really enjoy Maths because I learn strategies and it stretches my brain and makes me able to tackle problems. (Lulu. Written story). | During the first term I would get low marks and I would (get) feel bad about myself. (Lisa. Written story)          |

|                 |                                                               |                                                            |                                                                                 |
|-----------------|---------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------------------------------|
| Reason for code | Learner describes her perception of the nature of mathematics | Learner's description of herself as a mathematics learner. | Learner's reflections of her emotions in engagement in mathematical enterprise. |
|-----------------|---------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------------------------------|

Table 4.8, below, shows an example of utterances from Lulu's interactive interview grouped according to Solomon's categories.

Table 4.8 Solomon's (2009) strands of social and cultural activity categories

| <b>Narratives about the nature of mathematics</b>                                                                                                                 | <b>Narratives about oneself as a mathematics learner</b>                                                                                                                                                                                                                                                                                                                                                 | <b>Narratives about engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Learners come to school with preconceived perceptions that they gather in their social networks and develop new perceptions about the nature of mathematics.      | What learners believe about themselves in regard to mathematics are their mathematical identities.                                                                                                                                                                                                                                                                                                       | Learners' participation or engagement in mathematical activities                                                                                                                                                                                                                                                                                                                                                     |
| <p>...I found it interesting... (Lulu i5)</p> <p>So, I tried to enjoy it, but didn't enjoy it as much because it is a difficult subject after all. (Lulu i14)</p> | <p>In grade 4 I really enjoyed algebra and all the other kinds of stuff since it was my first time experiencing those types of maths, it was like a shift from grade 1, 2, 3 to grade 4 so I found it interesting and I wrote exams on the maths, which was also fine. (Atha i5)</p> <p>So, I tried to enjoy it, but didn't enjoy it as much because it is a difficult subject after all. (Lulu i14)</p> | <p>... she made it fun in many ways like involving games and stuff in class even though we were in high school, she involved games and then she made us do challenges, we would challenge each other in class for prizes and stuff, so it made it pretty cool. (Lulu i8)</p> <p>... you still have to practise at home and you can't practise if you don't understand what you were taught in class. (Lulu i13*)</p> |

Since I was exploring individual mathematics learner identities, I analysed data from each learner separately and in relation to the research questions. I used the "modes of belonging" and Solomon's three strands to analyse individual data from learners' stories and interactive interviews. Subsequently, the mathematics identities of the fourteen learners were also considered collectively for commonalities and differences. The two sources of data (learner stories, learner interviews) added richness to the data and allowed for some triangulation.

### 4.13 CODING FOR THE EMERGING THEMATIC NARRATIVES

The stories were coded in three ways that represent two levels. The first level and the broadest categorisation emerged from noticing that thematic narratives were emerging. That is presented in this section. At a second, deeper level, is the categorisation and coding of the utterances according to the two theoretical frameworks: Solomon's strands (2009) and Wenger's (1998) modes of belonging. While presented here before the data, the following three sections reveal some of the initial steps in my analysis of the stories, as the thematic narratives in particular were emergent categories and the manner in which Solomon (2009) and Wenger's (1998) frameworks are used were during early processing of the data.

The table below provides a list of the thematic narrative types that are presented in this section.

Table 4.9 Thematic Narratives Types

|      |                                      |      |                                                     |
|------|--------------------------------------|------|-----------------------------------------------------|
| TN1  | Primary school teacher narrative     | TN2  | Club coordinator narratives                         |
| TN3  | High school teacher narratives       | TN4  | Narratives about parental involvement               |
| TN5  | Narratives about external assistance | TN6  | Mathematics club narratives                         |
| TN7  | Enjoyed mathematics                  | TN8  | Mathematics narratives                              |
| TN9  | Mathematics as the gatekeeper        | TN10 | Mathematical Literacy narratives                    |
| TN11 | Mathematics was hard                 | TN12 | Imagination of future lifelong mathematics learning |

#### 4.13.1 Primary school teacher narrative – TN1

These are the narratives where learners specifically mention their primary school teachers' influence in their learning of mathematics. The narratives are split into two, which is the narratives when learners describe the assistance they received from their teachers (TN1a) or when they mention how the teachers' conduct ruined their engagement in the mathematics practice (TN1b). The excerpts from Cebisa and Nkosi that, "Grade 5 was ok because I had a good Maths teacher, so she explained everything really well" (Cebisa. Spoken - TN1a) and "My maths teacher helped me to change that mindset. She showed just because people think maths is hard does not mean it should be hard to me too" (Nkosi. Written - TN1a) represents how some learners' narratives portrayed how the teachers influenced their learning of mathematics and their subsequent construction of positive mathematics identities. The quotation from Zimkhitha represented narratives where learners were negatively affected by

the teachers' conduct, "and then in Grade 6, it was a bit harder because the things they taught us at maths club didn't help me well, because my teacher had her own way of explaining and I wanted to get her way and not the maths club way, ...so Grade 7 wasn't easy..." (Zimkhitha. Spoken-TN1b).

#### **4.13.2 Club coordinator narratives - TN2**

These narratives described instances where learners talked about seeking and receiving assistance from the club coordinators. These two excerpts represented the examples of the club coordinator narratives, "I talked to (club coordinator) about the issue about how to solve  $x$ 's, she helped me (Khethiwe. Written) and that "So I attended the club, so things were better because (club coordinator) was keeping asking which chapter we are struggling with and help us with that by playing games" (Funeka. Written).

#### **4.13.3 High school teacher narratives - TN 3**

These are narratives where learners discuss how their teacher helps to ameliorate their mathematics alignment and engagement (TN3a) or when they actually caused the learners to disalign and disengage in mathematical activities (TN3b). The quotations from Lulu illuminate how the high school teacher helped her to construct positive MLI, "She clearly explained maths concepts and I would get and understand the work easily. Every Math class I would look forward to what she was going to teach" (Lulu. Written-TN3a). However, some teachers caused the learners to disengage from mathematics as exemplified by the following quote,

And then in Grade 10, no Grade 9 we moved to another teacher and she was very fast and maths isn't like an easy subject you have to practice and all, so it isn't nice when a teacher, just like fast forwards through the things and you just there, because you still have to practice at home and you can't practice if you don't understand what you were taught in class (Lulu. Spoken- TN3b).

#### **4.13.4 Narratives about parental involvement - TN 4**

These are narratives where learners received specific mathematics assistance from their parents or guardians outside the school for example when Khethiwe explains that, "I got help from my father because he loves maths and he is able to do it" (Khethiwe. Spoken) or the counselling that, "...my father taught me that I should understand I won't get everything right all the time" (Akhona. Written).

#### **4.13.5 Narratives about external assistance - TN5**

These are narratives about how learners described the various assistance that was rendered to them by friends and other people in their landscapes of mathematics practice. For example, Aphiwe's acknowledgement that, "At the Intermediate phase it started to become hard for me and I used to find help to (sic) those around me or former students at my school" (Aphiwe. Written) is representative of narratives where learners received external assistance.

#### **4.13.6 Mathematics club narratives - TN6**

Narratives about the activities in the after school mathematics clubs include narratives about the benefits of the after school mathematics club activities to learners (TN6a) and challenges that learners came across that are related to the strategies or tricks they learnt in the clubs (TN6b). For example, "It's when I started maths club, in the maths club we had an opportunity to count using cards and we used very exciting maths activities. I loved the maths club because we had maths tricks that we used while doing an activity" (Esihle. Written-TN6a). Some learners faced challenges where, for example "in Grade 6, it was a bit harder because the things they taught us at maths club didn't help me well, because my teacher had her own way of explaining" (Esihle. Spoken-TN6b).

#### **4.13.7 Enjoyed mathematics - TN7**

The code is divided into three sub codes to represent the learners' enjoyment in successful engagement and alignment in their mathematics trajectories from primary school to high school. The sub code [TN7-FP] represents enjoyment of mathematics in the FP, and [TN7-IP] represents enjoyment of mathematics in the IP while [TN7-HS] represents the learners' enjoyment of mathematics in high school. The codes include narratives about learner affinity for mathematics because it is easy, fun, enjoyable and sometimes hard and challenging but learners managed to achieve favourable results. The following excerpts are representative of learners' narratives about enjoyment in their mathematics trajectories, "From Grade 1, maths was very fun and easy to solve because I was getting used to school and stuff, so I enjoyed maths from Grade 1, and when the years were passing, so Grade 2 was fun and I really enjoyed maths" [FN7-FP] (Aphiwe. Spoken). According to Lulu, "Maths in grade four went pretty well since I had a good foundation from my previous preparatory school. In grade five it was quiet (sic) manageable and grade six too" [FN7-IP] (Lulu. Written). Another example is, "In grade 8 in 2018 I was doing maths which was not that hard, but it was understandable and enjoyable but sometimes it was very tricky..." [FN7-HS] (Funeka. Written story).



#### **4.13.8 Mathematics narratives – TN8**

These are stories where learners discuss the nature of mathematics and how they interacted with the subject. The stories vary from their successful engagement and alignment [TN8a] to instances where they discuss disengagement and disalignment [TN8b] in the mathematics practice. In this representative example Lindelwa described her views of that nature of mathematics that “when I joined the Maths club it made me realise that maths isn’t that hard and it is not about getting the right answer, but it was about understanding it, making everything fun and coming up with great new ideas on how to solve maths problems” [TN8a] (Lindelwa. Written).

The following excerpt illustrates how some learners disengaged from successful mathematics practice, “I was struggling again because maths was not the same, we were working with big numbers” [TN8b] (Funeka. Written).

*Note: I adopted the word ‘disalignment’ rather than ‘misalignment’ in the manner of Bertrand and Goujon (2017), who use it as an indicator of potential trouble in understanding certain mathematical concepts.*

#### **4.13.9 Mathematics as the gatekeeper – TN9**

These are narratives about the importance of mathematics as the gatekeeper in life for example the quotation that, “Most careers need maths” (Funeka. Written story).

#### **4.13.10 Mathematical Literacy narratives - TN10**

Narratives about the nature of Mathematical Literacy. The narratives included how learners perceived the subject in terms of whether it was difficult or easy to do for example Aphiwe’s story that, “...I would do Mathematical Literacy because it is easy for me to understand” (Aphiwe. Written story).

#### **4.13.11 Mathematics was hard - TN11**

The code is divided into three sub codes to represent the various challenges that learners faced in their engagement and alignment in their mathematics trajectories from primary school to high school. Narratives of learners’ disengagement or disalignment due to the difficulty of the subject in FP are representative of utterances such as “Maths was a little hard in grade 2 than in grade 1” [TN11-FP] (Lisa. Written story). The utterance, “There were times when I would be so lost in class and even battle in assignments” [TN11-IP] (Lulu. Written story) is representative of utterances that reflect challenges that learners faced in the IP. Lastly, the

utterance, “I had the most difficult time in grade 9. Everything I learned was painful to me” (Anathi. Written story) is representative of the difficulty of the subject in high school.

#### **4.13.12 Imagination of future lifelong mathematics learning - TN12**

Narratives about learners’ imaginations of their future engagement or disengagement in post high school life for example, “I’m going to do maths, because if I do maths there are many opportunities that I have and I think maths, maths is better than maths lit” (Lindelwa. Spoken story).

### **4.14 CODING RULES FOR THE MODES OF BELONGING**

I describe the coding rules of the modes of belonging that I adopted from Wenger (1998) and Wenger-Trayner and Wenger-Trayner (2015).

#### **4.14.1 Engagement**

Engagement is described as active involvement in mutual processes of negotiation of meaning and it shapes experiences of who we are and how we are seen by others in society (Wenger, 1998). Put in simpler terms, engagement is the most immediate relation to a practice where learners engage in various activities, do certain things, work alone or together, interact, use and produce artefacts (Wenger, 2000; Wenger-Trayner & Wenger-Trayner, 2015). For the purposes of this study, my indicator of engagement is the learners’ most immediate successful involvement in mathematical group activities or mention of how they experienced challenges that limited mathematical practices.

Engagement involves mutuality in working on issues, reflecting, and debating in the various learning communities that learners pass through. It entails direct experience of regimes of competence, whether learners’ engagement is a visit or a lifetime commitment, whether the result is an experience of competence or incompetence and whether they develop an identity of participation or non-participation (Wenger-Trayner & Wenger-Trayner, 2015). I use this mode to glean participants’ views on engagement in individual or group mathematical work, or regarding how they experienced challenges that limited their engagement in mathematical group work (Oppland-Cordell & Martin, 2015).

#### **4.14.2 Alignment**

Wenger (1998) defines alignment as the way we coordinate our energy and activities to fit within broader structures and contribute to broader enterprises. Goodnough (2010) asserts that alignment involves establishing common ground and defining broad visions through which

members communicate and through which they also belong to a practice. In this study my indicator for alignment is the learners' compliance with various rules and regulations in learning mathematics, failure of which may result in learners having limited engagement opportunities.

Learners' engagement is rarely effective in practice without alignment with the context, coordination of activities, and implementation of regulations and intentions (Wenger-Trayner & Wenger-Trayner, 2015). In relation to alignment I look for utterances that explain learners' responses to relevant instructions and regulations. I present examples of learners' utterances from stories and interviews that fall under the different modes of belonging in Table 4.9, below.

### 4.14.3 Imagination

Imagination "refers to a process of expanding our self by transcending our time and space and creating new images of the world and ourselves" (Wenger, 1998 p. 176). Imagination also focuses on self-awareness and reflection in relation to understanding others and their actions, connecting to new trajectories and locating ourselves in landscapes of practice, creating new artefacts and processes, exploring new ways of doing things, and seeing new identities for ourselves (Goodnough, 2010). In this study the indicators of imagination are the learners' reflections and descriptions of the images of their past, present and future in mathematics education.

In this study I will therefore consider a phrase, sentence or group of consecutive sentences from stories or interactive interviews that describe learners' involvement in mathematical activities as modes of belonging (see examples in Table. 5.1).

Table 4.10 Modes of belonging

| <b>Modes of belonging</b> | <b>Example</b>                                                                                                                                                                                                                                               | <b>Description of why this example is a coded as such</b>       |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| <b>Engagement</b>         | So, I tried to enjoy it, but didn't enjoy it as much because it is a difficult subject after all. (Lulu. Spoken story)                                                                                                                                       | experience of challenges that limited mathematical practice.    |
|                           | Grade 9 was also nice because the teacher who taught maths was also very enthusiastic, we could understand what she was teaching, so, in grade 9 it wasn't really difficult in a way because we could understand what was being taught. (Lulu. Spoken story) | experience of successful involvement in mathematical activities |

|                    |                                                                                                                                                                                                                                                                   |                                                                                                                          |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
|                    | ... now I'm getting there with the hard work and effort I'm putting in my work. (Aphiwe. Written story)                                                                                                                                                           | experience of successful involvement in mathematical activities                                                          |
|                    | We stayed together and worked as a team and we were able to pass Math... (Nkosi. Written story)                                                                                                                                                                   | experience of successful involvement in mathematical group activities                                                    |
| <b>Imagination</b> | There was no one no extra class like the maths club I felt alone without the maths club in the new school. (Esihle. Written story)                                                                                                                                | self-awareness and reflection in relation to understanding one's actions, and locating oneself in landscapes of practice |
|                    | In everything I did that has something to do with Maths I would think of (the club coordinator) and (the club coordinator)'s words. (Lindelwa. Written story)                                                                                                     | reflecting on past experiences to solve present mathematical practices                                                   |
|                    | I think it's going to be good for me the way I've developed because maths trains me on how to solve things critically and I think it is going to be good and I will manage. (Anathi. Spoken story).                                                               | reflecting on past experiences to solve present and future mathematical practices                                        |
|                    | I think maths will help me because I want to be a doctor. (Funeka. Spoken story)                                                                                                                                                                                  | reflection on how past and present experiences will help to solve future images of the world                             |
|                    | I chose to give up and quit school if they were to teach me Maths. (Zimkhitha. Written story).                                                                                                                                                                    | self-awareness and reflection in relation to understanding one's actions, and locating oneself in landscapes of practice |
| <b>Alignment</b>   | I couldn't understand the difference between the signs of multiplication, subtraction and adding. (Khethiwe. Written story)                                                                                                                                       | failure to comply with various rules and regulations in learning mathematics                                             |
|                    | Now it is a bit difficult with the different, you get more information on what you already know but then it's like I can't let go of what I already know first and then it's hard to adapt to the new things you are learning in grade 10. (Anathi. Spoken story) | failure to comply with various rules and regulations in learning mathematics                                             |
|                    | I struggled when it became to solving problems like (x) so I decided when I'm in High School I would do Mathematical Literacy because it is easy for me to understand. (Aphiwe. Written story).                                                                   | establishing common ground with various rules and regulations in learning mathematics                                    |
|                    | Maths club had really set a good foundation for me and that's when I realised that I have a love for numbers. (Cebisa. Written story).                                                                                                                            | establishing common ground with various rules and regulations in learning mathematics                                    |

#### **4.15 LIMITATIONS OF THE STUDY**

The study focused on a cohort of learners from three after school mathematics clubs that were hosted for at least two years at three different primary schools in Makhandu, beginning in 2012 and 2013. This is admittedly a limiting factor when it comes to generalisation of the findings, as different institutions provide different experiences that exert varying influences on the emerging MLIs (Wenger, 1998). However, focusing on learners who participated in after school maths clubs from three primary schools and on fourteen purposely selected participants provided a deep understanding of the phenomenon concerned, which was the construction of mathematics identity by a cohort of learners who shared much in common.

#### **4.16 SUMMARY**

This chapter has outlined the research orientation of the study and the methodology employed. I discuss the importance of qualitative research methods for my exploration of the mathematics identities of learners who participated in after school mathematics clubs. The chapter also provides information about the research site, the data collection methods and the analytical frameworks utilised. I conclude with a discussion of key methodological issues concerning ethics, and the validity and reliability of the data.

A case study research design was used to study high school learners who had participated in the SANC after school mathematics clubs in primary school. The case study combined qualitative and interpretive methodologies to gather in-depth and detailed data from selected learners. Fourteen learners were finally chosen to participate in the study, which took place from March 2018 to October 2020. The study gathered the requisite data from written narratives and follow-up interactive interviews with the learners. The data collection methods enabled the collection of sufficient data for exploration of the emerging MLIs of high school learners who participated in after school mathematics clubs in primary school. The data was analysed using narrative analysis and interpreted using a framework devised from Wenger's (1998) modes of belonging and propositions from Solomon's (2009) social and cultural activity theory. This data forms the basis of the next two chapters, which investigate how high school learners' identities and practices evolved in relation to their participation in after school mathematics clubs.

## **CHAPTER 5**

### **PRESENTATION OF DATA**

#### **5.1 INTRODUCTION**

In this chapter I present the study data from the participants. It is important to recall that the data I present was generated from written and spoken narratives from 14 participants. The prompt that was given to participants to write their stories was to ‘write your story of yourself as a mathematics learner from Grade 1 to now’, while in the spoken stories they were asked to ‘tell their mathematics stories from Grade 1 to now’. I begin by explaining the coding rules that I adapted from Wenger’s modes of belonging and the Solomon categories that I used to assist in the analysis of data. From my initial reading of the learners’ stories, I present them as grouped into 12 distinct thematic narrative categories.

I further provide brief notes that contextualise the learners’ written and spoken narratives that describe how they traversed the learning landscape through primary and high school learning communities, including passing through the SANCP after school mathematics club community. I also highlight learners’ narrative mathematical identities in primary school, in the SANCP after school mathematics clubs, in high school and in their imagined future.

When speaking of the learners’ written and spoken words, i.e. the actual written ‘story’ and spoken ‘story’, I use the word ‘story.’ In other words, I use the word ‘story’ to refer to the written artefact and the interview transcript. Taken together these form the narrative that was analysed. When referring to the codes and themes and meaning within the story, I refer to ‘narrative’ in alignment with my theoretical framing. Where I write of Mathematics (capitalised) I am referring to the school subject, as with Mathematical Literacy.

The learners I worked with, being in Grade 9 and 10, had made their choices to continue doing Mathematics or to do the alternative, Mathematical Literacy. Eleven learners had chosen to continue doing Mathematics while three had chosen Mathematical Literacy as shown in table 5.1.

Table 5.1 Learners' choices (all names are pseudonyms)

| Name of learner | Gender | Grade | Subject of choice     |
|-----------------|--------|-------|-----------------------|
| Aphiwe          | F      | 10    | Mathematical Literacy |
| Sisipho         | F      | 10    | Mathematical Literacy |
| Zimkhitha       | F      | 9     | Mathematical Literacy |
| Lulu            | M      | 10    | Mathematics           |
| Akhona          | M      | 10    | Mathematics           |
| Anathi          | F      | 10    | Mathematics           |
| Cebisa          | F      | 10    | Mathematics           |
| Ayabonga        | F      | 10    | Mathematics           |
| Nkosi           | M      | 10    | Mathematics           |
| Esihle          | F      | 9     | Mathematics           |
| Khethiwe        | F      | 9     | Mathematics           |
| Lisa            | F      | 9     | Mathematics           |
| Funeka          | F      | 9     | Mathematics           |
| Lindelwa        | F      | 9     | Mathematics           |

## 5.2 PRESENTATION OF LEARNER NARRATIVES

For a detailed explanation of the coding rules of the 12 distinct thematic narratives and the Solomon strands categories, together with the Wenger (1998) modes of belonging, refer to 4.14 to 4.16 in the methodology chapter.

In the following sections I present each learner's written and spoken stories (Tables 5.2 to 5.15), as separated into utterances. Recall that an utterance is defined as being a phrase, sentence or group of consecutive sentences that convey a single idea (see section 4.13.1) Each utterance is coded using Solomon's (2009) strands, Wenger's (1998) modes of belonging as well as the 12 thematic narratives explained in section 4.14. Each utterance is numbered according to the order in which it appeared in the written story or the spoken story. The reader can read each utterance in numerical order to read the original, uncoded texts. These are also available as Appendix F to Appendix R.

The table organises these utterances into three columns, each referring to one of the three strands of Solomon's (2009) framework: narratives about the nature of mathematics; narratives about oneself as a mathematics learner; and narrative of engagement in mathematics. Within each column, each utterance is categorised according to one (or more, where relevant) thematic

narrative (e.g. [TN7]) and according to Wenger's (1998) three modes of belonging that are indicated by using the initials E for engagement, A for alignment, and I for imagination, and a combination where needed.

In addition, certain phrases within an utterance could be coded elsewhere in Solomon's (2009) strands. To show this, segments of some utterances are underlined, and reappear in a different column, indicated there by an asterisk.

For every learner I first present a brief overview of the thematic narratives that appear in their stories, and a count of how many times they appear in their narratives (e.g. 6 utterances, TN11-IP). After the tables presenting the data, I write brief notes that contextualise the narratives further and also highlight learners' narrative mathematical identities in the past (primary school and in the SANCP after school mathematics clubs), in high school (past and present) and in their imagined future where applicable. This provides a sense of the learners' mathematical identity trajectory. Lastly, I give a summary of the learner's identity narratives.

I begin by presenting the narratives of three learners who chose to do Mathematical Literacy in Grade 10, post the compulsory schooling stage, followed by the eleven stories of learners who chose to continue doing Mathematics in Grade 10 and beyond. Learners who were in Grade 9 during the research had made this choice by the time the interviews were conducted and so I am able to assign them to either the Mathematical Literacy or the Mathematics groups (see Table 5.1).

### **5.2.1 Aphiwe: Narrative**

The thematic narratives that Aphiwe focuses on in his written and spoken stories, are largely about instances where he sought external assistance in Mathematics from friends (8 utterances, TN5) and his engagement in the after school mathematics club (4 utterances, TN6). His mathematics story (3 utterances, TN10) also relates his enjoyment of mathematics in the FP (7 utterances, TN7-FP), IP (5 utterances, TN7-IP) and high school (4 utterances, TN7-HS). His narrative further chronicles the difficult episodes he encountered in FP (4 utterances, TN11-FP), IP (6 utterances, TN11-IP) and high school (4 utterances, TN11-HS). Interestingly, Aphiwe does not mention his club coordinator in his narrative.

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Aphiwe's written and spoken stories.

Table 5.2 Aphiwe's narrative



| Written Story                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Narratives about the nature of mathematics                                                                                                                                                                                                                                                                                                                                                                                  | Narratives about oneself as a mathematics learner                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>1. I remember doing mathematics at Grade 1, it was very enjoyable and exciting to do. [TN7-FPFP] (E/I)</p> <p>3*. Maths could be challenging. [TN11-FP] (E/I)</p> <p>4*. At the Intermediate phase it started to become hard for me [TN7-IP, TN5] (E/I)</p> <p>7*. ...I would do Mathematical Literacy because it is easy for me to understand [TN12] (E)</p> <p>9*. Sometimes it could be confusing [TN11-HS] (E/I)</p> | <p>2. I really enjoyed it at my Pre years then [I was introduced to Maths Club which really made me understand it easily and ways to solve problems*] [TN7-FP, TN6b] (E/I)</p> <p>2*. I was introduced to Maths Club which really made me understand it easily and ways to solve problems [TN6a] (E/I)</p> <p>3*. I would stay focused and find a way to get through it. [TN7-FP] (I)</p> <p>5. Because I'm a hard-working learner. [TN7-FP] (A)</p> <p>6. I would take the challenge and try to work it out on my own. [TN7-IP, TN11-IP] (A)</p> <p>7. I struggled when it became to solving problems like (x) so I decided when I'm in High School [I would do Mathematical Literacy because it is easy for me to understand.*] [TN11-HS, TN12, TN7-HS] (I/A)</p> <p>8*. As for now I really enjoy Mathematical Literacy and I think I've made a great decision for myself. [TN7-HS, TN12] (E/I)</p> <p>9*. I taught myself to ask for help if it gets hard or confuses me. [TN5] (E)</p> <p>11*. I'm getting there with the hard work and effort I'm putting in my work. [TN7-IP] (E)</p> | <p>3. At sometimes [Maths could be challenging*] but [I would stay focused and find a way to get through it*]. [TN7-FP, TN11-FP] (E/I)</p> <p>4. [At the Intermediate phase it started to become hard for me*] and [I used to find help to those around me or former students at my school.*] [TN7-IP, TN5] (E)</p> <p>4*. I used to find help to those around me or former students at my school [TN5] (E)</p> <p>8. [As for now I really enjoy Mathematical Literacy and I think I've made a great decision for myself*]. [TN7-HS, TN12] (E/I)</p> <p>9. [Sometimes it could be confusing*] but [I taught myself to ask for help if it gets hard or confuses me*]. [TN11-HS, TN5] (E)</p> <p>10. When I was introduced to it, I thought it was easy so it got rough for me because I used to chill with unlikely friends. [TN11-HS] (E)</p> <p>11. So now [I'm getting there with the hard work and effort I'm putting in my work*]. [TN7-IP] (E)</p> |
| Spoken story: Interview                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Narratives about the nature of mathematics                                                                                                                                                                                                                                                                                                                                                                                  | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1. From Grade 1, maths was very fun and easy to solve [<u>because I was getting used to school and stuff, so I enjoyed maths from Grade 1, and when the years were passing, so Grade 2 was fun and I really enjoyed maths.*</u>] [TN7-FP, TN10a] (E)</p> <p>2. Even Grade 3, there was starting to be a little bit of difficulty]. [TN10b, TN11-FP] (E)</p> <p>4*. ...then from Grade 8 I dropped in maths from Grade 8 because it was really difficult. [TN11-IP] (E/I)</p> <p>5* ...maths, is challenging [TN11-IP] (E/I)</p> | <p>1* .... because I was getting used to school and stuff, so I enjoyed maths from Grade 1, and when the years were passing, so Grade 2 was fun and I really enjoyed maths. [TN7-FP] (E)</p> <p>3. [<u>But hey, teachers were really helping, and then maths club came, I think it was Grade 3 and 4, maths club came and helped me with after school classes that I was attending here*</u>], then Grade 4, yah Grade 4, there was some difficulty, but I struggled through the studies, being helped by Ma'am to understand]. [TN1a, TN2, TN6a, TN11-IP] (E)</p> <p>4*. yeoh, it was beating me, but because of my classmates and the teacher they tried to help me... [TN5] (E/I)</p> <p>5. Then from Grade 8 solving x, and problem solving there, but in Grade 9, I told myself that when I get to Grade 10 I think I will do maths lit, because I understand it more, I was getting it I knew I was going to pass, so [<u>maths, is challenging.*</u>] [<u>but if you work hard and ask for help from people, they will help me and so I enjoy the maths*</u>] [TN7-HS, TN12, TN11-IP] (E/A)</p> <p>7. I don't think that I will use maths, because in the future I am thinking of being a social worker, but maths, I will still do maths for other purposes. [TN16] (I)</p> | <p>3*. but if you work hard and ask for help from people, they will help me and so I enjoy the maths [TN5, TN7-HS] (E)</p> <p>3*. But hey, teachers were really helping, and then maths club came, I think it was Grade 3 and 4, maths club came and helped me with after school classes that I was attending here. [TN1a, TN6a] (E)</p> <p>4. Grade 7, yeoh its Grade 7, then we were introduced to easy stuff, but, yeoh, <u>it was beating me, but because of my class mates and the teacher they tried to help me*,]</u> but [<u>then from Grade 8 I dropped in maths from Grade 8 because it was really difficult*</u>]. [TN10b, TN11-IP, TN5] (E/I)</p> <p>5*. but if you work hard and ask for help from people, they will help me and so I enjoy the maths</p> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[\*] denotes a phrase extracted to be coded additionally elsewhere

### 5.2.1.1 Aphiwe's narrative and Solomon's strands

#### *Aphiwe's narrative about the nature of mathematics*

Aphiwe's narrative about the nature of mathematics in his written story changes as he moves along his trajectory through the various landscapes of practice. He reports that in the past, he

was a learner who was aligned with the subject as his engagement was enjoyable and exciting, and he proceeds to then describe himself as disaligned in saying that the subject is challenging and confusing. He describes the nature of the subject differently as he progresses in his mathematical journey. He narrates that, when he started school, in Grade 1, he found that mathematics “was very enjoyable and exciting to do” (Aphiwe. Written, 1). But he imagines that in future, he “would do Mathematical Literacy because it is easy for me to understand” (Aphiwe. Written, 7). In other terms, he aligns more with Mathematical Literacy than Mathematics.

As Aphiwe progressed with his mathematical journey, his narrative about the nature of mathematics changed. He explained that he was a learner who found that “at ...times Maths could be challenging...” (Aphiwe. Written, 3) and “sometimes it could be confusing” (Aphiwe. Written, 9). He specifically mentions that in the past, “at the Intermediate phase it started to become hard for me” (Aphiwe. Written, 4).

In the spoken story Aphiwe says that he perceived mathematics as fun and easy in FP. He explained that in the past, “maths was very fun and easy to solve because I was getting used to school and stuff, so I enjoyed maths from Grade 1, and when the years were passing, so Grade 2 was fun and I really enjoyed maths” (Aphiwe. Spoken, 1). Aphiwe says that he aligned with FP Mathematics as it was generally easy, but he highlights some difficult episodes that in “... Grade 3, there was starting to be a little bit of difficulty” (Aphiwe. Spoken, 2).

Aphiwe explains that engagement in mathematics was more challenging in his final year in primary school and in high school:

Grade 7, yeoh its Grade 7, then we were introduced to easy stuff, but yeoh, it was beating me, but because of my classmates and the teacher they tried to help me, but then from Grade 8 I dropped in Maths from Grade 8 because it was really difficult (Aphiwe. Spoken, 4).

He reports that the difficulty persists in the present despite the assistance he receives from the teacher and his colleagues.

#### *Aphiwe’s narrative of himself as a mathematics learner*

Aphiwe presents himself as a learner whose elementary schooling laid a solid foundation for his potential to participate in mathematics. In his narrative, he chronicles that: “I really enjoyed it at my Pre years then I was introduced to Maths Club which really made me understand it easily and ways to solve problems” (Aphiwe. Written, 2).

His narrative describes a resolute and persevering learner who “...would stay focused and find a way to get through” (Aphiwe. Written, 3) mathematical challenges. His narrative that he was

“... a hard-working learner” (Aphiwe. Written, 5) may have given him enough conviction to persevere throughout primary school where he declared his love for the subject.

The affinity for mathematics may have developed in the after school mathematics club, “which really made (him) understand (mathematics) easily and ways to solve problems” (Aphiwe. Written, 2). He also describes himself as a learner who “would take the challenge and try to work it out on my own” (Aphiwe. Written, 6); this illuminates self-agency in Aphiwe. He further realises that as an individual he needed external assistance to circumvent some of the mathematical problems that he may come across and “taught (himself) to ask for help if it gets hard or confuses (him)” (Aphiwe. Written, 9).

Aphiwe wrote that he struggled with his engagement in algebra. He explained that, “so I decided when I’m in High School I would do Mathematical Literacy because it is easy for me to understand” (Aphiwe. Written, 7). He further explained that, “as for now I really enjoy Mathematical Literacy and I think I’ve made a great decision for myself” (Aphiwe. Written, 8) to choose a subject that he really loves. He concludes that: “I’m getting there with the hard work and effort I’m putting in my work” (Aphiwe. Written, 11).

In the spoken narrative, Aphiwe presents himself as a learner who draws proactively on assistance from people around him to excel in mathematics:

But hey, teachers were really helping, and then maths club came, I think it was Grade 3 and 4, maths club came and helped me with after school classes that I was attending here, then Grade 4, yah Grade 4, there was some difficulty, but I struggled through the studies, being helped by Ma’am to understand (Aphiwe. Spoken, 3).

He reiterates his belief about the importance of seeking assistance when one is faced by mathematical challenges in high school:

Then from Grade 8 solving  $x$ , and problem solving there, but in Grade 9, I told myself that when I get to Grade 10 I think I will do maths lit, because I understand it more, I was getting it, I knew I was going to pass, so maths, is challenging, but if you work hard and ask for help from people, they will help me and so I enjoy the maths (Aphiwe. Spoken, 5).

Aphiwe said he wants to pursue a career that does not involve much mathematics hence he decided to do Mathematical Literacy which he argued will help him in life:

I don’t think that I will use maths, because in the future I am thinking of being a social worker, but maths, I will still do maths for other purposes (Aphiwe. Spoken, 7).

#### *Aphiwe’s narrative of his engagement in mathematics*

The description of mathematics as exciting and enjoyable by Aphiwe may be linked to his stated perseverance and too much bravery, in breaking through mathematical obstacles.

Aphiwe wrote that in the past, he was willing to go an extra mile, seeking assistance on mathematical concepts that he failed to understand on his own. He narrates that “at the Intermediate phase it started to become hard for me and I used to find help to those around me or former students at my school” (Aphiwe. Written, 4).

He further describes his present successful alignment and engagement in mathematics: “As for now I really enjoy Mathematical Literacy and I think I’ve made a great decision for myself (Aphiwe. Written, 8). Sometimes it could be confusing, but “I taught myself to ask for help if it gets hard or confuses me” (Aphiwe. Written, 9).

Besides enjoying engagement in Mathematical Literacy, Aphiwe relates that, “when I was introduced to it, I thought it was easy so it got rough for me because I used to chill with unlikely friends” (Aphiwe. Written, 10). He recounts that he realised that the subject needed close attention for him to do well so he changed tack and “now I’m getting there with the hard work and effort I’m putting in my work” (Aphiwe. Written, 11).

In the spoken story, Aphiwe presents himself as an engaged mathematics learner who believes in hard work and seeking assistance when in doubt or does not understand something “...but if you work hard and ask for help from people, they will help me and so I enjoy maths” (Aphiwe. Spoken, 5).

### ***5.2.1.2 Aphiwe’s narrative and modes of belonging***

#### *Engagement*

Aphiwe explains his engagement and enjoyment in mathematics that, “I really enjoyed it at my Pre years then I was introduced to Maths Club which really made me understand it easily and ways to solve problems” (Aphiwe. Written, 2). When the enterprise became hard “I taught myself to ask for help if it gets hard or confuses me” (Aphiwe. Written, 9), he wrote that he would seek assistance from “those around me or former students at my school” (Aphiwe. Written, 4) so, he was a learner who appreciated that there were areas that he did not align with and showed agency in seeking assistance. He reiterates the assistance narrative that “teachers were really helping, and then maths club came, I think it was Grade 3 and 4, maths club came and helped me with after school classes that I was attending here” (Aphiwe. Spoken, 3).

Presently, his enterprise in mathematical engagement deteriorated and he blames it on the way he approached his school work in high school that, “when I was introduced to it, I thought it was easy so it got rough for me because I used to chill with unlikely friends” (Aphiwe. Written,

10). His engagement in mathematics shifted as he recounts that he decided to “do Mathematical Literacy because it is easy for me to understand” (Aphiwe. Written, 7).

### *Alignment*

Although Aphiwe failed to establish ‘common ground’ with the mathematics practice, he describes himself as “a hard-working learner” (Aphiwe. Written, 5) who chose to do “Mathematical Literacy because it is easy for me to understand” (Aphiwe. Written, 7). He further explains his disalignment with mathematics, especially “solving  $x$ , ...in Grade 9” which made him resolve “that when I get to Grade 10 I think I will do Maths Lit, because I understand it more, I was getting it, I knew I was going to pass, so maths, is challenging, but if you work hard and ask for help from people, they will help me and so I enjoy the maths” (Aphiwe. Spoken, 5).

### *Imagination*

Aphiwe reflects his perseverance in primary school when he writes that “sometimes Maths could be challenging but I would stay focused and find a way to get through it” (Aphiwe. Written, 3). However, he continued to imagine mathematics as challenging for him and chose Mathematical Literacy post the compulsory schooling stage, where he reflected that, “As for now I really enjoy Mathematical Literacy and I think I’ve made a great decision for myself” (Aphiwe. Written, 8) to choose an enterprise that he is comfortable and happy to engage in.

#### ***5.2.1.3 Summarising Aphiwe’s identity stories***

Aphiwe chronicles his enjoyment of mathematics in primary school and his perception that he was a focused and hardworking learner. While he says he experienced mathematics as fun and enjoyable, he also stories himself as a learner whose successful alignment with the mathematics enterprise was hard, challenging, and confusing at some stages in his mathematics journey.

He positions himself as a learner who believes that if a learner works hard and asks for help from more knowledgeable people whenever mathematics gets hard or confuses him, he will receive strategies that will help him to successfully align and enjoy mathematical practice in his learning trajectories. Interestingly, he does not mention the club coordinators in his narrative.

He imagines herself as a learner who conceptualises Mathematical Literacy in Grade 10 as easy to understand and enjoyable compared to Mathematics which is difficult and challenging.

Aphiwe's imagined trajectory of his lifelong mathematics is as a learner of Mathematical Literacy as he imagines himself as a social worker, an occupation that he argues does not require intensive mathematics.

### 5.2.2 Sisipho: Narrative

In both her stories, Sisipho describes her engagement in the after school mathematics club (4 utterances, TN6) and narrates her enjoyment of mathematics in the FP (4 utterances, TN7-FP), IP (1 utterance, TN7-IP) and high school (6 utterances, TN7-HS). She also speaks about her high school Mathematical Literacy teacher's (1 utterance, TN3) passion in teaching and how he takes time to explain concepts until everyone understands. She further expounds that her engagement had few difficult episodes both in the IP (2 utterances, TN11-IP) and high school (3 utterances, TN11-HS).

The majority of her narratives relate to Mathematical Literacy (9 utterances, TN12), the subject which she chose to pursue post the compulsory schooling stage in Grade 10 and in future (1 utterance, TN16).

Lastly, Sisipho does not mention the following narratives, primary school teacher narrative (TN1), club coordinator narratives (TN2), narratives about parental involvement (TN4), narrative about Mathematics as a gatekeeper (TN9) and narratives about difficulties in FP (TN11-IP).

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Sisipho's written and spoken stories.

Table 5.3 Sisipho's narrative

| Written Story                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Narratives about the nature of mathematics                                                                                                                                                                                                | Narratives about oneself as a mathematics learner                                                                                                                                                                                                                                                                                                         | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <p>2. At that time maths was fun and easy to do. [TN7-FP] (I)</p> <p>4. grade 7 the maths started to get a bit harder. [TN11-IP] (E)</p> <p>6. First lessons for maths lit were great and I found it easy and fun. [TN12, TN7-HS] (E)</p> | <p>5. At high school I chose maths lit the reason I did so was because I find it hard to solve questions that included solving for x. [TN12] (A)</p> <p>10. After it I was so stressed because I was thinking that I am going to fail but I did not. [TN12] (E/I)</p> <p>11. to conclude all I am happy with Maths and I enjoy it and I am willing to</p> | <p>1. I remember now it's almost 9 years ago when I was introduced to maths and that was in Foundation phase. [TN7-FP] (I)</p> <p>3. Then at grade 3 at Mountview Primary we were introduced to maths club were we learnt more about maths and did fun maths exercises. [TN7-FP, TN6a] (E)</p> <p>4. Years went by things started to change a bit [<u>in grade 7 the maths started to get a bit harder*</u>] but I managed and passed and went to high school!! [TN11-IP, TN7-IP] (E)</p> <p><u>5. At high school I chose maths lit the reason I did so was because [I find it hard</u></p> |



|                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                      | <p>learn more about maths. [TN12, TN7-HS] (I)</p>                                                                                                                                                                                                                                                                                                                                                                             | <p>to solve questions that included solving for x.*] [TN12] (A)</p> <p>6. [First lessons for maths lit were great and I found it easy and fun*]. [TN12, TN7-HS] (E)</p> <p>7. Our teacher is such a great teacher because he won't like skip to other thing without others that don't follow or understand. [TN3a] (E)</p> <p>8. My teacher told us that we were going to write a test okay okay fine I was excited for the test. [TN12] (E/I)</p> <p>9. The day came I forgot how to calculate forgot the formulas but I writes the test and finished it. [TN11-HS] (E/I)</p> <p>11. I was so happy to see my first term report because I got level 5 for maths [lit] and I was so relived and happy to conclude all [I am happy with Maths [Lit] and I enjoy it and I am willing to learn more about maths [lit].*] [TN12, TN7-HS] (I)</p> |
| <b>Spoken Story: Interview</b>                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Narratives about the nature of mathematics</b>                                    | <b>Narratives about oneself as a maths learner</b>                                                                                                                                                                                                                                                                                                                                                                            | <b>Narratives of engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <p>1. First of all, in Grade 1 it was all easy stuff until Grade 3. [TN7-FP] (E)</p> | <p>3. But then in high school, Grade 8 was fine because I remembered I passed all terms getting good marks in maths and [then Grade 9 I struggled a bit, yes in grade 9*.] [TN7-HS, TN11-HS] (E)</p> <p>3*. then Grade 9 I struggled a bit, yes in Grade 9. [TN11-HS] (E)</p> <p>5. And then I chose maths lit in Grade 10 and then it is easier for me than pure maths because I could not solve the x thing, it is very</p> | <p>2. And then we joined the maths club and then from there we learnt different strategies to calculate different sums and then up to Grade 7 it was all going well. [TN6a] (E/A)</p> <p>4. But getting help from my friends, the ones I was in the group with, the maths club, yes. [TN5] (E)</p> <p>6. And then from then until we came back again when we meet here and then got other strategies on how to work out things. [TN6a] (E/A)</p> <p>7. So, the things that we do here we also do in school, so it makes things easier. [TN7-HS] (E)</p>                                                                                                                                                                                                                                                                                      |

|  |                                         |                                                                                                                                                                                                                                                                                                                    |
|--|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | hard for me to do that.<br>[TN12] (A 5) | 8. So, when the teacher speaks now I can remember that oh it is the other thing that we've done there, so far I'm still getting...<br>[TN6a] (E/A)<br><br>9. I think my maths story could help me in the future because some things are easy to remember, and I think they could help me in the future. [TN16] (I) |
|--|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[\*] denotes a phrase extracted to be coded additionally elsewhere

### 5.2.2.1 Sisipho's key narrative and Solomon's strands

#### *Sisipho's narrative about the nature of mathematics*

Sisipho reports that she was a learner who believed that mathematics in primary was largely “fun and easy to do” (Sisipho. Written, 2), but in “grade 7 the maths started to get a bit harder” (Sisipho. Written, 4). Her sense of the nature of mathematics shows that the subject is easier in the FP but shifted to become very hard as she moves to the IP and to high school in particular. When she started primary school, mathematics “was all easy stuff until Grade 3” (Sisipho. Spoken, 1). This assertion shows that she was a learner who enjoyed engagement in mathematical practices in the FP. The positive engagement seemed to dissipate as Sisipho progressed to upper grades. This is evident in her decision to choose the less difficult Mathematical Literacy at Grade 10. She explicates that “I chose Maths Lit in Grade 10 and then it is easier for me than pure Maths because I could not solve the x thing, it is very hard for me to do that” (Sisipho. Spoken, 5). Her decision to settle for an easier subject illuminates her desire to work with a subject that is comfortable for her.

#### *Sisipho's narrative about oneself as a maths learner*

At high school, Sisipho writes that she was not confident with mathematics and “chose Maths Lit, the reason I did so was because I find it hard to solve questions that included solving for x” (Sisipho. Spoken, 5).

She explains that although she initially found Mathematical Literacy easy and fun, she later on narrates that she was not always confident about the subject. She tells a story of when she wrote a Mathematical Literacy test that, after the test “I was so stressed because I was thinking that I am going to fail but I did not” (Sisipho. Written, 10).

Overall, Sisipho concludes that: “I am happy with Maths (Literacy) and I enjoy it and I am willing to learn more about maths (literacy)” (Sisipho. Written, 11).

In the spoken narrative interview, she had mixed stories about herself as a mathematics learner. She describes mathematics as both slightly difficult and enjoyable as she journeyed from primary to high school. She was a learner who reflected about her work in high school that, "... Grade 8 was fine because I remembered I passed all terms getting good marks in maths and then Grade 9 I struggled a bit, yes in Grade 9" (Sisipho. Spoken, 3). She believed that she was largely a good mathematics learner although she once in a while faced some challenging episodes. She probably looked back into her Mathematics performance and realised that Mathematics was too difficult for her and the area that she felt comfortable in was Mathematical Literacy.

Sisipho explains that her failure to solve algebraic expressions convinced her that she could not continue with Mathematics but Mathematical Literacy. And now she relates that she is comfortable and confident so much that "... when the teacher speaks now, I can remember that oh it is the other thing that we've done there, so far I'm still getting..." (Sisipho. Spoken, 8).

She also believes that the mathematical knowledge that she acquires in school would be useful when she finishes school, hence it was imperative that she continues working hard. She imagines that, "maths... could help me in the future because some things are easy to remember, and I think they could help me in the future" (Sisipho. Spoken, 9).

#### *Sisipho's narrative of her engagement in mathematics*

Sisipho relates in her narrative that, "at grade 3 at Mountview Primary we were introduced to maths club were (sic) we learnt more about maths and did fun maths exercises" (Sisipho. Written, 3). She explains that engagement in mathematics shifted because as "years went by things started to change a bit in grade 7 the maths started to get a bit harder but I managed and passed and went to high school!!" (Sisipho. Written, 4).

In high school, she chose to pursue Mathematical Literacy: "First lessons for maths lit were great and I found it easy and fun" (Sisipho. Written, 6). She gives credit to her teacher who "is such a great teacher because he won't like skip to other thing without others that don't follow or understand" (Sisipho. Written, 7).

In her engagement in mathematics, she tells a story when the teacher "told us that we were going to write a test okay okay fine I was excited for the test. (Sisipho. Written, 8). The day came I forgot how to calculate, forgot the formulas but I writes [sic] the test and finished it" (Sisipho. Written, 9). However, in the end: "I was so happy to see my first term report because I got level 5 for maths [literacy] and I was so relieved and happy, to conclude all I am happy

with Maths (Literacy) and I enjoy it and I am willing to learn more about maths (literacy)” (Sisipho. Written, 11).

Sisipho describes herself as an active participator in mathematical activities when she wrote that, “... we joined the maths club and then from there we learnt different strategies to calculate different sums and then up to Grade 7 it was all going well” (Sisipho. Spoken, 2). Her engagement in the after school mathematics club strengthened her mathematical awareness as she points out that she learnt different strategies to calculate different sums. She acknowledges external assistance in her engagement in mathematics when she explained that she sometimes “struggled a bit...” (Sisipho. Spoken, 3), but got “help from my friends, the ones I was in the group with, the maths club” (Sisipho. Written, 4).

Sisipho shows further appreciation of external assistance and mathematical tips and resources she received from the SANCP Fun Day activities when she explains that “when we meet here and then got other strategies on how to work out things (Sisipho. Spoken, 6) ...the things that we do here we also do in school, so it makes things easier” (Sisipho. Spoken, 7).

#### ***5.2.2.2 Sisipho’s narrative and modes of belonging***

##### *Engagement*

Sisipho chronicles her engagement in mathematics and focuses on her participation in the SANCP after school mathematics clubs that, “we were introduced to maths club were [sic] we learnt more about maths and did fun maths exercises (Sisipho. Written, 3) and “learnt different strategies to calculate different sums and then up to Grade 7 it was all going well” (Sisipho. Spoken, 2). She further expounds that she is a learner who manages to synchronise what she learns in the clubs with her schoolwork that, “the things that we do here we also do in school, so it makes things easier (Sisipho. Spoken, 7). So, when the teacher speaks now, I can remember that oh it is the other thing that we’ve done there, so far I’m still getting...” (Sisipho. Spoken, 8).

In high school, “Grade 8 was fine because I remembered I passed all terms getting good marks in Maths and then Grade 9 I struggled a bit, yes in Grade 9” (Sisipho. Spoken, 3). The difficult episodes in Grade 9 probably made her decide to choose to pursue Mathematical Literacy in Grade 10, and she recounts that: “First lessons for maths lit were great and I found it easy and fun (Sisipho. Written, 6). Our teacher is such a great teacher because he won’t like skip to other thing without others that don’t follow or understand” (Sisipho. Written, 7).

### *Alignment*

Sisipho treasures the experience she acquired in the SANCP after school mathematics clubs where she “learnt different strategies to calculate different sums.” In the words of Wenger (1998), the ‘strategies’ would assist her to coordinate her energy and activities to fit within broader structures and contribute to broader mathematical enterprises.

In high school, she chose to pursue Mathematical Literacy post the compulsory schooling stage and she relates finding comfort in its concepts and the teacher’s pedagogical practices that, “I chose Maths Lit in Grade 10 and then it is easier for me than pure Maths because I could not solve the x thing, it is very hard for me to do that” (Sisipho. Spoken, 5). Additionally, she still thinks back to the after school club work that, “when the teacher speaks now I can remember that oh it is the other thing that we’ve done there, so far I’m still getting” (Sisipho. Spoken, 8) good passes in Mathematical Literacy.

### *Imagination*

She reflects that, in primary school, “maths was fun and easy to do” (Sisipho. Written, 2), but in high school she chose Mathematical Literacy which was easy for her. She recounts her imagination that, “I was so happy to see my first term report because I got level 5 for maths [Literacy] and I was so relieved and happy, to conclude all, I am happy with Maths [Literacy] and I enjoy it and I am willing to learn more about maths [Literacy]” (Sisipho. Written, 11).

Although Sisipho is not explicit about her future mathematical practice post high school, she imagines that her “maths story could help me in the future because some things are easy to remember, and I think they could help me in the future” (Sisipho. Spoken, 9).

#### ***5.2.2.3 Summarising Sisipho’s identity stories***

Sisipho positions herself as a learner who views primary school mathematics as easy in primary school but difficult in high school.

Her narrative about herself is as a learner whose participation in different landscapes of mathematics was enhanced by the various strategies that she acquired from the after school mathematics clubs.

Sisipho chose to align herself with Mathematical Literacy in Grade 10 because mathematics was harder for her in Grade 9.

Her narrative about herself is as a learner who enjoys Mathematical Literacy as it is great, easy and fun.

Sisipho imagines using the Mathematical Literacy skills in future as some concepts are easy to remember, and she thinks they will be helpful to her in future.

### 5.2.3 Zimkhitha: Narrative

The thematic narratives that are dominant in Zimkhitha's stories are about enjoyment of mathematics in the FP (6 utterances, TN7-FP), IP (5 utterances, TN7-IP) and in high school (4 utterances, TN7-HS). She also narrates contrasting stories about her primary school teachers (3 utterances, TN1) where on the one hand she remembers one passionate teacher while on the other hand she relates having tough times trying to understand the other teacher's way of solving mathematics problems. The latter teacher's methods were different from what Zimkhitha was taught and had become used to in the after school mathematics club (6 utterances, TN2) which she describes as having helped her to be a competent mathematics learner. She also explains that she used to receive assistance from her friend (2 utterances, TN5) at home.

Her narratives further chronicle the difficult episodes she encountered in FP (6 utterances, TN11-FP), IP (3 utterances, TN11-IP) and high school (5 utterances, TN11-HS) which probably made her choose to do Mathematical Literacy in Grade 10 (1 utterance, TN12). She did not speak about TN4, TN6 and TN16 at all.

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Zimkhitha's written and spoken stories.

Table 5.4 Zimkhitha's narrative

| <b>Written Story</b>                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Narratives about the nature of mathematics</b>                                                                                                                                   | <b>Narratives about oneself as a mathematics learner</b>                                                                                                                                                                                                                                                                                                                             | <b>Narratives of engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p>21. They told us that Maths could get us far. [TN10a, TN9] (I)</p> <p>25. It was very hard at the beginning that I even failed my first term of High School. [TN11-HS] (E/A)</p> | <p>1. When I first arrived in the school namely Icawa Primary I wasn't a good catcher when it comes to learning maths. [TN11-FP] (I)</p> <p>3. I wasn't excelling in it or understanding it. [TN11-FP] (I)</p> <p>4. I chose to give up and quit school if they were to teach me Maths. [TN11-FP] (E/I)</p> <p>7. I went to the next which was Grade 2 I was excelling in it and</p> | <p>2. I met a friend who usually helped me with my maths homeworks because she was a bit older than me and was excelling in maths. [TN5] (E)</p> <p>5. My helper usually came to my house to show me some tricks, but it only took me a year to understand maths. [TN5] (E)</p> <p>6. When I writes my Anna [Annual National Assessment] exam I was not sure if I could get it right and pass my exam but with God's grace I passed it with flying colours and got a level 7 &amp;</p> |

|  |                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>I was one of the toppest student. [TN7-FP] (E/I)</p> <p>11. I was passing maths from that year till I got to S. Msholoz Primary. [TN7-FP] (I/A)</p> <p>26. After I saw my results from the first term I told myself that I will again be the same person I was in Primary. [TN7-HS] (I)</p> <p>28. I am good maths learner and I'm very proud of myself. [TN7-HS] (I)</p> | <p>that gave me power to love and to continue doing it till I loved it. [TN7-FP] (E/A/I)</p> <p>8. My teacher taught me tricks that were going to challenge me in the next grade. [TN1a] (E)</p> <p>9. In grade 3 I was given a certificate for maths and I was given an award. [TN10a] (E/A)</p> <p>10. My teacher bought me a chocolate. [TN1a] (I)</p> <p>12. In grade 4 which I was doing at S. Msholoz Primary my class teacher was Mrs [T] and my maths teacher was also Mrs [T]. [TN1a] (E/I)</p> <p>13. I was chosen by Mrs [Y] because of my good marks in maths. [TN10a] (E/I)</p> <p>14. When I first heard the word "Maths Club" I knew that it was all about fun and teaching tricks of maths. [TN6a] (E/I)</p> <p>15. Our maths club teacher was (the club coordinator) who taught us nothing but good about maths and taught us tricks about maths which we used to teach other learners in class. [TN6a, TN2] (E)</p> <p>16. I wasn't sure about the fact that I was chosen to be in the club. [TN6a] (I)</p> <p>17. (the club coordinator) did a good work by inspiring us and was a good example to us. [TN2] (E/I)</p> <p>18. She took us as her children and we took her as our mother. [TN2] (E)</p> <p>19. In 2016 was when (the club coordinator) came to introduce us to (the club coordinator). [TN2] (I)</p> |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



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|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                      |                                                                                                                                                                                                                                                                                                       | <p>20. We worked very good with her and (the club coordinator). [TN2] (E)</p> <p>21. They told us that Maths could get us far. [TN10a, TN9] (I)</p> <p>22. I passed maths from those years until I finished Primary. [TN10a, TN7-IP] (I/A)</p> <p>23. I was then going to start my higher grades at Sikelela Secondary School. (E)</p> <p>24. When I arrived there I forgot everything that (the club coordinator) and (the club coordinator) taught me. [TN2] (E/I)</p> <p>25. It was very hard at the beginning that I even failed my first term of High School. [TN11-HS] (E/A)</p> <p>26. After I saw my results from the first term I told myself that I will again be the same person I was in Primary. [TN7-HS] (I)</p> <p>27. I then began to be same person I was in Primary until today. [TN7-HS] (E)</p> |
| <b>Spoken Story: Interview</b>                                                                                                       |                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Narratives about the nature of mathematics</b>                                                                                    | <b>Narratives about oneself as a mathematics learner</b>                                                                                                                                                                                                                                              | <b>Narratives of engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p>2. it was kind of easy. [TN7-FP] (E)</p> <p>5. it was so easy. [TN7-IP] (E)</p> <p>6. ...it was a bit harder... [TN11-IP] (E)</p> | <p>1. Okay, ka Grade 1, I was not good in maths, so I was struggling a lot. [TN11-FP] (E)</p> <p>2. And then it took me a year to understand what is maths? and then in Grade 2, I was feeling like [it was kind of easy*], but then [I was stuck in division*] and then Grade 3, it was fine, it</p> | <p>3. And then Grade 4 that's when I started the maths club. [TN6a] (E)</p> <p>4. So, in Grade 4 the maths club really helped me because I got to know new strategies, [I've learnt a lot and then <u>since there, from Grade 4, I continued using the... the strategies they taught us, I followed them in order to get maths well*</u>]. [TN6a, TN7-IP] (E/A)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7. it's tough. [TN11-IP] (E)              | was better. [TN7-FP, TN11-FP] (E/A/I)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 4. I've learnt a lot and then since there, from Grade 4, I continued using the... the strategies they taught us, I followed them in order to get maths well. [TN7-IP] (E/A)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 9. ...maths is confusing... [TN11-HS] (E) | 2. I was stuck in division [TN11-FP] (E/A/I)<br><br>5. And then in Grade 5, [ <u>it was so easy*</u> ] because I knew from maths club, so they usually helped me a lot. [TN7-IP] (E)<br><br>7. So from high school, I was struggling in Grade 8 but [ it was difficult, but I passed] level 3, [But in primary I passed with level 6s and 7s, so in my head I knew I had to go back to maths club] now Grade 9, [ <u>it's tough*</u> ] but I'm trying to get there. I'm finished. [TN6a, TN11-HS, TN10] (E)<br><br>8. Since like I'm focusing now mostly, in Grade 8 I was not focusing on maths stuff, in Grade 10 now I will be good in maths lit because I understand these things (maths lit) not the pure maths things, I didn't understand anything there]. [TN12] (E) | 6. And then in Grade 6, [ <u>it was a bit harder*</u> ] because the things they taught us at maths club didn't help me well, because my teacher had her own way of explaining and I wanted to get her way and not the maths club way, ....so Grade 7 wasn't easy, ....and then Grade 7 I finished maths club because we went to high school]. [TN1b, TN11-IP] (E/A)<br><br>9. In the future I want, I think I will be studying for five years, so like I'll go to various schools and try to tell them my maths story and tell them how I learnt and the various maths strategies, and that [ <u>maths is confusing*</u> ] here/for some, and then what to do on the other side/hand. [TN10a, TN16 TN11-HS] (E/A) |

[\*] denotes a phrase extracted to be coded additionally elsewhere

### 5.2.3.1 Zimkhitha's narrative and Solomon's strands

#### *Zimkhitha's narrative about nature of mathematics*

Zimkhitha writes that the after school mathematics club coordinators made her, and her fellow club members believe in the gatekeeper effect that the subject has: "They told us that Maths could get us far" (Zimkhitha. Written, 21). Although she believed that mathematics has a gatekeeper effect, in high school: "It was very hard at the beginning that I even failed my first term of High School" (Zimkhitha. Written, 25).

In the spoken narrative, Zimkhitha describes mathematics as "so easy" (Zimkhitha. Spoken, 5) in the FP until Grade 5. Starting from Grade 6, mathematics was "a bit harder" (Zimkhitha. Spoken, 6). Later on, in high school, she describes mathematics as tough and confusing. The

conceptualisation of mathematics as tough and confusing did affect her choice to either pursue or drop mathematics in Grade 10 as shown later.

#### *Zimkhitha's narrative about herself as a mathematics learner*

When she started primary school, Zimkhitha writes that, “I wasn’t a good catcher when it comes to learning maths” (Zimkhitha. Written, 1) in fact, she “wasn’t excelling in it or understanding it” (Zimkhitha. Written, 3). She reveals that the situation was so bad that “I chose to give up and quit school if they were to teach me Maths” (Zimkhitha. Written, 4).

Zimkhitha explains that she was a learner who took “a year to understand maths” (Zimkhitha. Written, 5) and she narrates then when she understood mathematics, she became the top mathematics learner in her class and she excelled in her tests in class. She asserts that, “I was passing maths from that year till I got to S. Msholozzi Primary” (Zimkhitha. Written, 11).

When she moved to high school, she wrote that she failed the first examination there and after she saw her “results from the first term I told myself that I will again be the same person I was in Primary” (Zimkhitha. Written, 26), a person who used to pass mathematics. She asserts that, “I am a good maths learner and I’m very proud of myself” (Zimkhitha. Written, 28).

Zimkhitha explains that she “was struggling a lot” (Zimkhitha. Spoken, 1) in Mathematics. Her spoken narrative story shows that she believes that mathematics was difficult, and she went on to choose not to pursue it post-Grade 9. She describes herself as a learner who found out she was a good learner in Mathematical Literacy when she reflected that, “I will be good in Maths Lit because I understand these things (maths lit) not the pure maths things, I didn’t understand anything there” (Zimkhitha. Spoken, 8). In other words, she perceives herself as a competent Mathematical Literacy learner.

#### *Zimkhitha's narrative of her engagement in mathematics*

Zimkhitha explains that she mostly relied on external assistance in her mathematics work. She explained in the written narrative that, “I met a friend who usually helped me with my maths home works because she was a bit older than me and was excelling in maths” (Zimkhitha. Written, 2). The friend “usually came to my house to show me some tricks, but it only took me a year to understand maths” (Zimkhitha. Written, 5).

With her friend’s assistance she excelled in the Annual National Assessment, where she describes that “I was not sure if I could get it right and pass my exam but with God’s grace I

passed it with flying colours and got a level 7 & that gave me power to love and to continue doing it till I loved it” (Zimkhitha. Written, 6).

She further points out that “my teacher taught me tricks that were going to challenge me in the next grade” (Zimkhitha. Written, 8) and “in grade 3 I was given a certificate for maths and I was given an award” (Zimkhitha. Written, 9).

She continued her successful engagement in mathematics when she joined the after school mathematics club which she explains that:

When I first heard the word “Maths Club” I knew that it was all about fun and teaching tricks of maths. Our maths club teacher was (coordinator’s name) who taught us nothing but good about maths and taught us tricks about maths which we used to teach other learners in class. (The club coordinator) did a good work by inspiring us and was a good example to us (Zimkhitha. Written, 14-17).

At the after school mathematics club, the coordinators “told us that Maths could get us far” (Zimkhitha. Written, 21). Zimkhitha therefore worked hard until she finished her primary education.

When she started high school, she reveals that: “When I arrived there, I forgot everything that (the club coordinators) taught me (Zimkhitha. Written, 24). It was very hard at the beginning that I even failed my first term of High School” (Zimkhitha. Written, 25).

She relates that after she saw her failed results she vowed to work hard and become “the same person I was in Primary” (Zimkhitha. Written, 26) when she used to excel in mathematics. She continues that, “I then began to be the same person I was in Primary until today” (Zimkhitha. Written, 27).

In the spoken narrative story, Zimkhitha’s reflections show that she took part and benefited from the after school mathematics club:

So, in grade 4 the maths club really helped me because I got to know new strategies, I’ve learnt a lot and then since there, from grade 4, I continued using the... the strategies they taught us, I followed them in order to get maths well. (Zimkhitha. Spoken, 4).

Zimkhitha further discusses her imagined future engagement in mathematics. She expounds that, “I’ll go to various schools and try to tell them my maths story and tell them how I learnt and the various maths strategies, and that maths is confusing here/for some, and then what to do on the other side/hand” (Zimkhitha. Spoken, 9).

She tells a story about the conflict between different mathematical practices from the landscapes of practice that:

And then in Grade 6, it was a bit harder because the things they taught us at maths club didn't help me well, because my teacher had her own way of explaining and I wanted to get her way and not the maths club way, ....so Grade 7 wasn't easy, ....and then Grade 7 I finished maths club because we went to high school (Zimkhitha. Spoken, 6).

### ***5.2.3.2 Zimkhitha's narrative and modes of belonging***

#### *Engagement*

Zimkhitha recounts that her involvement in mathematics practice was limited in the past as "I was not good in maths...I was struggling a lot" (Zimkhitha. Spoken, 1). She even contemplated giving up and quitting school if they continued teaching her mathematics, but "I met a friend whom usually helped me with my maths home works because she was a bit older than me and was excelling in maths" (Zimkhitha. Written, 2).

She explains that when she found assistance from her friend, she passed her annual assessment and explains that, "that gave me power to love and to continue doing it till I loved it" (Zimkhitha. Written, 6). In the following grades her teacher taught her "tricks that were going to challenge me in the next grade" (Zimkhitha. Written, 8) and she also passed and proceeded to IP.

She continued to use the tricks learnt from her previous teacher and the SANCP after school mathematics clubs in Grades 4 and 5 but had challenges in Grade 6 when the classroom teacher's pedagogical practices clashed with the methods she had learned in the after school mathematics clubs. She expounds that, "in Grade 6, it was a bit harder because the things they taught us at maths club didn't help me well, because my teacher had her own way of explaining and I wanted to get her way and not the maths club way, ....so Grade 7 wasn't easy, ....and then Grade 7 I finished maths club because we went to high school" (Zimkhitha. Spoken, 6).

The mathematical obstacles continued in high school where she reveals that in "high school, I was struggling in Grade 8 but it was difficult...I passed level 3, but in primary I passed with level 6s and 7s, so in my head I knew I had to go back to maths club" (Zimkhitha. Spoken, 7). She continues that, "now Grade 9, it's tough but I'm trying to get there" (Zimkhitha. Spoken, 7). The mathematics practice obstacles that she continually experienced influenced her choice post the compulsory schooling stage where she decides that, "in Grade 10, now I will be good in Maths Lit because I understand these things (Maths Lit) not the pure Maths things, I didn't understand anything there" (Zimkhitha. Spoken, 8).

### *Alignment*

In the FP, Zimkhitha successfully coordinated her mathematics activities and managed to pass her assessment “with flying colours” (Zimkhitha. Written, 6) and she expounds that this “gave me power to love and to continue doing it, till I loved it” (Zimkhitha. Written, 6). Her alignment with mathematics regulations culminated in her receiving “a certificate for maths and I was given an award” (Zimkhitha. Written, 9).

Zimkhitha expounds that in the SANCP after school mathematics club, the facilitator “taught us nothing but good about maths and taught us tricks about maths which we used to teach other learners in class” (Zimkhitha. Spoken, 5). She adds that, “I’ve learnt a lot, and then since there, from Grade 4, I continued using the... the strategies they taught us, I followed them in order to get maths well” (Zimkhitha. Spoken, 4). She continues to use the tricks in the classroom and “passed maths from those years until I finished Primary” (Zimkhitha. Written, 22).

Zimkhitha narrates failure to comply with mathematics regulations in high school because: “It was very hard at the beginning that I even failed my first term of High School” (Zimkhitha. Written, 25)

### *Imagination*

Zimkhitha reflects that in the past, she “wasn’t a good catcher when it comes to learning maths” (Zimkhitha. Written, 1) and “wasn’t excelling in it or understanding it” (Zimkhitha. Written, 3). Even when she wrote her annual assessment, she describes her passing as an act of “God’s grace”, but that “that gave me power to love and to continue doing it till I loved it” (Zimkhitha. Written, 6). Her perseverance paid off as in the following grade her performance shifted and was excelling in mathematics where she describes herself as “one of the toppest (sic) students” (Zimkhitha. Written, 7) in her grade.

She further imagines that she was selected to join the SANCP after school club “because of my good marks in maths” (Zimkhitha. Written, 13) and reveals that when: “I first heard the word “Maths Club” I knew that it was all about fun and teaching tricks of maths” (Zimkhitha. Written, 14). In the club, the coordinators, “did a good work by inspiring us and was a good example to us” (Zimkhitha. Written, 17). She recounts that the coordinators repeatedly “told us that Maths could get us far” (Zimkhitha. Written, 21) and “I passed maths from those years until I finished Primary” (Zimkhitha. Written, 22).

### ***5.2.3.3 Summarising Zimkhitha's identity stories***

Zimkhitha's narrative about herself is as a learner who perceives herself as not being a good catcher of mathematics concepts and who once decided to give up and quit school because mathematics was a bit harder for her. While she says she initially experienced mathematics as hard in primary school, she later passed the subject from Grade 2 until she finished primary school. She positions herself as a learner who at one time became the top performing learner in Grade 2 and received a certificate for being best in mathematics.

In the narrative, she stories herself as a learner who received immense assistance in the form of strategies and tricks for solving mathematics problems in the different mathematics landscapes of practice from the SANCP after school mathematics club.

She further aligns herself with Mathematical Literacy post the compulsory schooling stage because she experienced difficulties in high school mathematics. Zimkhitha aligns herself with Mathematical Literacy where she describes herself as a good and proud Mathematical Literacy learner.

### 5.2.4 Lulu: Narrative

Lulu's mathematical stories (26, TN10) prominently feature written and spoken narratives that relate to her enjoyment of mathematics in the FP (9 utterances, TN7-FP), IP (7 utterances, TN7-IP) and high school (18 utterances, TN7-HS). She also tells of the difficult episodes where she says she struggled in negotiating the mathematics obstacles in the IP (6 utterances, TN11-IP) and high school (12 utterances, TN11-HS).

In her narratives, Lulu shows that she recognises the significant roles of external assistance (3 utterances, TN5), the after school mathematics club (2 utterances, TN6) and her high school teachers (12 utterances, TN3) in her successful engagement and alignment in her mathematics practice.

Although she seems to be competent in mathematics, Lulu says she does not intend to pursue the subject in tertiary education because her future career prospect does not require advanced mathematics (1 utterance, TN16).

Lulu does not mention her primary school teachers (TN1), the club coordinator (TN2), or her parents (TN4) in her narrative.

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Lulu's written and spoken stories.

Table 5.5 Lulu's narrative

| Written Story                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Narratives about the nature of mathematics                                                                                                                                                                                                                                                    | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                                                                                                                           | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                           |
| <p>13. In grade five it was quiet [sic] manageable and grade six too. [TN7-IP] (I)</p> <p>16. And in grade seven algebra was a bit of a problem in some sections where there were algebraic fractions... [TN11-IP] (A)</p> <p>18*. Maths started being a fun subject for me. [TN7-HS] (E)</p> | <p>3. <u>[I would just simply and easily get an answer by using my fingers to add and subtract answer by using my fingers to add and subtract from the given sums*]</u> [TN7-FP] (E)</p> <p>6. I really enjoyed Maths at school [TN10a, TN7-IP] (E)</p> <p>7. <u>[There I was so active and I would really look forward to Maths club every week since we would play Mathematical games and get strategies on</u></p> | <p>1. My journey of mathematics has been one interesting, fascinating, and SURELY CHALLENGING route [TN10a] (I).</p> <p>2. From the easy and simple one sums, to the times tables which we had to learn in pre-primary which is from grade 1 to 3. [TN7-FP] (E)</p> <p>3*. I would just simply and easily get an answer by using my fingers to add and subtract answer by using my fingers to</p> |



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| <p>25. Maths therefore in grade 9 for me was very easy and enjoyable [TN7-HS] (I)</p> <p>26. That is where I got to describe Maths as MIND BLOWING. [TN7-HS] (I)</p> <p>28. Mathematics is very interesting. [TN7-HS] (I)</p> <p>31. So in grade 10 Maths is not AS FUN as the lower grades since it is more challenging, developed and requires a lot (of) knowledge and thinking [TN11-HS] (E/I)</p> <p>32. It is fun and interesting a lot but it is more stressful than it is FUN. [TN7-HS] (I)</p> | <p><u>how to solve problems*.</u>] [TN6a, TN10a] (E)</p> <p><u>11. [I really enjoyed finding Highest Common Factors and lowest common multiples*]</u> [TN7-IP] (A)</p> <p><u>12. [Maths in grade four went pretty well since I had a good foundation from my previous preparatory school*]</u> [TN7-IP] (I)</p> <p>15*. I would be so lost in class and even battle in assignments. [TN11-IP] (I)</p> <p>17. I understood what was going on in class and I was very engaged. [TN7-HS] (I)</p> <p>18. I even understood the grade 7 work that I didn't get and <u>[Maths started being a fun subject for me*]</u>. [TN7-HS] (E)</p> <p><u>19. [I would feel very eager to have a maths period*]</u>. (E/A) [TN7-HS]</p> <p>21*. She clearly explained maths concepts and I would get and understand the work easily. [TN3a] (E/A)</p> <p>22*. Every Maths class I would look forward to what she was going to teach [TN3a] (I)</p> <p>24*. I would easily be able to apply concepts to given problems and be able to solve them [TN7-HS] (E)</p> <p>29*. There are sections where I had to spend days trying to understand after being taught in class [TN11-HS] (E)</p> <p>30*. I had times where I didn't fully understand some sections and that made me feel very</p> | <p>add and subtract from the given sums [TN7-FP] (E)</p> <p>4. I remember where we would also count apples, bananas etc. [TN7-FP, TN10a] (E)</p> <p>5. We would get so easy tests on Bonds which were the times tables and we would only get tested on one thing at a time, in other words one maths section at a time [TN7-FP] (E)</p> <p>6. [I also participated in the Maths Club since <u>[I really enjoyed Maths at school.*]</u>] [TN6a, TN10a, TN7-IP] (E)</p> <p>7*. There I was so active, and I would really look forward to Maths club every week since we would play Mathematical games and get strategies on how to solve problems [TN6a, TN10b] (E)</p> <p>8. That was grade three.</p> <p>9. Then came grade four, the intermediate phase where things started being real. [TN11-IP, TN10b] (I)</p> <p>10. We were introduced to factorising, simple algebra etc. [TN10b] (E/A)</p> <p>11. I really enjoyed finding Highest Common Factors and lowest common multiples. [TN7-IP] (A)</p> <p>12*. Maths in grade four went pretty well since I had a good foundation from my previous preparatory school. [TN7-IP] (I)</p> <p>14. Then came grade seven where we got into deeper algebra. [TN10b] (A/I)</p> <p>15. There were times when <u>[I would be so lost in class and</u></p> |
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|  | <p>miserable and not want to have Maths and not want Maths periods to happen and cause me to panic. <b>[TN11-HS] (I)</b></p> <p>33. I really enjoy Maths because I learn strategies and it stretches my brain and makes me able to tackle problems. <b>[TN7-HS] (I)</b></p> | <p><u>even battle in assignments*.</u>] <b>[TN11-IP] (I)</b></p> <p>16. And in grade seven algebra was a bit of a problem in some sections where there were algebraic fractions, there my interest in Maths was quiet very low due to that I then started High school in grade 8, I had a very loving and calm Maths teacher. <b>[TN11-IP, TN3a] (E/A)</b></p> <p><u>17. [I understood what was going on in class and I was very engaged*].</u> <b>[TN7-HS] (I)</b></p> <p>19. I would feel very eager to have a maths period. <b>[TN7-HS] (I)</b></p> <p>20. The following year in grade 9, I was taught maths by an old and caring teacher. <b>[TN3a] (E/I)</b></p> <p><u>21. [She clearly explained maths concepts and I would get and understand the work easily*].</u> <b>[TN3a] (E/A)</b></p> <p><u>22. [Every Math class I would look forward to what she was going to teach*].</u> <b>[TN3a] (E)</b></p> <p>23. She would show us solutions to the problems which when I saw, I would be like “Oh WoW!” <b>[TN3a] (I)</b></p> <p>24. She made us stretch our minds and <u>[I would easily be able to apply concepts to given problems and be able to solve them*]</u> <b>[TN3a, TN7-HS] (E I)</b></p> <p>27. Then there’s me now in grade 10. <b>(I)</b></p> <p>29. There are sections which when you are introduced to, you easily understand but <u>[there are sections where I had to spend</u></p> |
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| <b>Spoken Story: Interview</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Narratives about the nature of mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Narratives about oneself as a maths learner</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Narratives of engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p>1. So in Grade 1 it was my first maths, [so in Grade 1 I experienced maths and it was like actually fun and all, because it wasn't like, I didn't really have to apply much knowledge to solve the sums and that stuff, because it was just simple maths; ok 1 plus 1 and then also using pictures to like work out sums*] [TN7-FP, TN10a] (E/A/I)</p> <p>2. And then Grade 2 it was pretty much the same thing; it was all fun. [TN7-FP, TN10a] (E/A/I)</p> <p>3. And then Grade 3, it was also pretty much the same thing, at least it was notch up a bit to a higher level. [TN10a, TN7-FP, TN11-FP] (E/A/I)</p> <p>5*. I found it interesting... [TN7-IP] (I)</p> | <p>5. In Grade 4 I really enjoyed algebra and all the other kinds of stuff since it was my first time experiencing those types of maths, it was like a shift from Grade 1, 2, 3 to Grade 4 so [I found it interesting*] and I writes exams on the maths, which was also fine. [TN7-IP] (E/A/I)</p> <p>6. Then in Grade 5 pretty much the same thing till Grade 6. [TN7-IP] (I)</p> <p>8*. ... in Grade 8 I really enjoyed maths because the teacher that taught maths was very enthusiastic and she made it fun in many ways... [TN3a, TN10a, TN7-HS] (A/I)</p> <p>9. And then we were introduced to other chapters in maths and then the part that I really struggled with was analytical geometry. [TN10a, TN11-HS] (E/A)</p> <p>10. Like congruency and triangles and all that, I struggled a bit then I moved onto Grade 9 and we carried on with the Grade 8 work and then</p> | <p>1*. ...so in Grade 1 I experienced maths and it was like actually fun and all, because it wasn't like, I didn't really have to apply much knowledge to solve the sums and that stuff, because it was just simple maths; ok 1 plus 1 and then also using pictures to like work out sums [TN7-FP, TN10a] (E/A)</p> <p>4. Then in Grade 4 that's when I started my exams, so we had to start learning algebra and all the different, all the other types of sections in maths. [TN10a] (E)</p> <p>8. Then when I got to high school, [in Grade 8 I really enjoyed maths because the teacher that taught maths was very enthusiastic and she made it fun in many ways*] like involving games and stuff in class even though we were in high school, she involved games and then she made us do challenges, we would challenge each other in class for prizes and stuff, so it made it pretty cool. [TN3a, TN10a, TN7-HS] (E/A/I)</p> |

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| <p>7. Then in Grade 7 we were introduced to different other things, then that's when it started being serious, because we were also going to move onto high school. [TN11-IP] (E/A)</p> <p>14*. ...it is a difficult subject after all. [TN11-HS] (E/I)</p> <p>16. Then in Grade 10 maths is ok, but then there's a big shift from Grade 1, 2, 3, 4 to now. [TN10a] (E/A)</p> <p>17. It's not as exciting, especially because I'm doing mathematics not pure maths so yah. [TN10a, TN11-HS] (E/A)</p> | <p>new things were introduced. [TN10a, TN11-HS] (E/A)</p> <p>11*. ...so, in Grade 9 it wasn't really difficult in a way because we could understand what was being taught. [TN7-HS] (E/A)</p> <p>12. Yah I enjoyed finance maths, because I did accounting, and I also did well with accounting, so I enjoyed finance. [TN10a, TN7-HS] (EA)</p> <p>14. So, I tried to enjoy it, but didn't enjoy it as much because <u>[it is a difficult subject after all*]</u>. [TN10b, TN11-HS] (E)</p> <p>19. So, until Grade 12 I have to do maths, then after school, after high school, I don't even, in varsity do we have to take maths or is it a choice? [TN10a] (I)</p> <p>20. It's a choice I'm not considering going to that side because I feel like it's going to challenge me a like a lot, and I'm not like, I get lazy at times and I feel like maths needs your full on attention. [TN10b, TN16] (I)</p> | <p>11. Grade 9 was also nice because the teacher who taught maths was also very enthusiastic, we could understand what she was teaching, <u>[so, in Grade 9 it wasn't really difficult in a way because we could understand what was being taught*]</u>. [TN3a, TN10a, TN7-HS] (E)</p> <p>13. And then in Grade 10, no Grade 9 we moved to another teacher and she was very fast and maths isn't like an easy subject you have to practice and all, so it isn't nice when a teacher, just like fast forwards through the things and you just there, because you still have to practice at home and you can't practice if you don't understand what you were taught in class. [TN3b, TN10b, TN11-HS] (E)</p> <p>15. Then in Grade 10, I have a new maths teacher, and I also understand things, and in Grade 9 we struggled with the maths exam, yah the external exam because I feel like in Grade 9 we were taught well, so we could apply the knowledge we have on other things, I'm still in Grade 9, so then we struggled with the exams because we moved to another teacher and I wasn't as flexible of whatever if that's how I can put it. [TN3b, TN10b, TN11-HS, TN7-HS] (E)</p> <p>18. In future as in?</p> <p>21. So, I think I'll leave it. [TN10b] (I)</p> |
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[\*] denotes a phrase extracted to be coded additionally elsewhere

#### 5.2.4.1 Lulu's narrative and Solomon's strands

*Lulu's narrative about the nature of mathematics*

Lulu's narratives about the nature of mathematics in primary school were largely positive. She recounts that: "In grade five it was quiet [sic] manageable and grade six too" (Lulu. Written, 13). In fact, for the larger part of her primary schooling, she describes mathematics as "being a fun subject for me" (Lulu. Written, 18), except for grade 7 where she explains that "algebra was a bit of a problem in some sections where there were algebraic fractions" (Lulu. Written, 16).

When she moved to grade 9, she reflects that she was a learner who found that mathematics "was very easy and enjoyable" (Lulu. Written, 25) and describes it as "MIND BLOWING (emphasis original)" (Lulu. Written, 26). Lulu further narrates that "Mathematics is very interesting" (Lulu. Written, 28), but in Grade 10 she warns that it "is not AS FUN (emphasis original) as the lower grades since it is more challenging, developed and requires a lot (of) knowledge and thinking (Lulu. Written, 31). It is fun and interesting a lot, but it is more stressful than it is FUN (emphasis original)." (Lulu. Written, 32).

In her spoken narrative, Lulu describes mathematics as fun and enjoyable on the one hand, and difficult and hard on the other. She narrates that in Grade 1 "it was like actually fun" (Lulu. Spoken, 1) and the trend continued up to Grade 3 where she reflects that, "... it was also pretty much the same thing, at least it was notch up a bit to a higher level" (Lulu. Spoken, 3). She relates that she was a learner who experienced mathematics as fun and enjoyable until the end of Grade 6.

"Then in Grade 7 we were introduced to different other things, then that's when it started being serious, because we were also going to move onto high school" (Lulu. Spoken, 7). From Grade 7, her narrative of the nature of mathematics then shifted as she writes that, "I tried to enjoy it but didn't enjoy it as much because it is a difficult subject after all" (Lulu. Spoken, 14). She relates that she was a learner who experienced mathematics as fun and enjoyable until the end of Grade 6.

"Then in Grade 7 we were introduced to different other things, then that's when it started being serious, because we were also going to move onto high school" (Lulu. Spoken, 7). From Grade 7, her narrative of the nature of mathematics then shifted as she writes that, "I tried to enjoy it but didn't enjoy it as much because it is a difficult subject after all" (Lulu. Spoken, 14). She relates that she was a learner who experienced mathematics as fun and enjoyable until the end of Grade 6.

“Then in Grade 7 we were introduced to different other things, then that’s when it started being serious, because we were also going to move onto high school” (Lulu. Spoken, 7). From Grade 7, her narrative of the nature of mathematics then shifted as she writes that, “I tried to enjoy it but didn’t enjoy it as much because it is a difficult subject after all” (Lulu. Spoken, 14). She continued that, “it’s not as exciting, especially because I’m doing mathematics not pure maths so yah” (Lulu. Spoken, 17). Although she expresses mixed feelings about the nature of mathematics in the past, presently she has chosen to continue doing mathematics in Grade 10 and explains that, “... in Grade 10 maths is ok, but then there’s a big shift from Grade 1, 2, 3, 4 to now” (Lulu. Spoken, 16).

*Lulu’s narrative about herself as a maths learner*

Lulu saw herself as a competent mathematics learner throughout her mathematics journey. She reflects in her written narrative that in the past she “would just simply and easily get an answer by using ... fingers to add and subtract from the given sums” (Lulu. Written, 3). She writes that continued that, “it’s not as exciting, especially because I’m doing mathematics not pure Maths so yah” (Lulu. Spoken, 17). Although she expresses mixed feelings about the nature of mathematics in the past, presently she has chosen to continue doing Mathematics in Grade 10 and explains that, “... in Grade 10 maths is ok, but then there’s a big shift from Grade 1, 2, 3, 4 to now” (Lulu. Spoken, 16).

*Lulu’s narrative about herself as a maths learner*

Lulu saw herself as a competent mathematics learner throughout her mathematics journey. She reflects in her written narrative that in the past she “would just simply and easily get an answer by using ... fingers to add and subtract from the given sums” (Lulu. Written, 3). She writes that she “really enjoyed Maths at school” (Lulu. Written, 6) and in particular grade 4 mathematics “went pretty well since I had a good foundation from my previous preparatory school” (Lulu. Written, 12). The good foundation helped her to understand “what was going on in class and I was very engaged” (Lulu. Written, 17).

Lulu explains that she was actively engaged in mathematics especially in the after school mathematics club and “would really look forward to Maths club every week since we would play Mathematical games and get strategies on how to solve problems” (Lulu. Written, 7).

In high school she expounds that her mathematics teacher’s pedagogical style enhanced her mathematical competence. She recounts that she “even understood the grade 7 work that I didn’t get, and Maths started being a fun subject for me (Lulu. Written, 18). I would feel very

eager to have a maths period” (Lulu. Written, 19). She continues that the mathematics teacher “clearly explained maths concepts and I would get and understand the work easily (Lulu. Written, 21). Every Math class I would look forward to what she was going to teach (Lulu. Written, 22). I would easily be able to apply concepts to given problems and be able to solve them” (Lulu. Written, 24). In addition, she states that, “I really enjoy Maths because I learn strategies and it stretches my brain and makes me able to tackle problems” (Lulu. Written, 33). Although she enjoyed mathematics in both primary and secondary school, she explained in the spoken narrative that there were moments that “I would be so lost in class and even battle in assignments” (Lulu. Written, 15) and that “there are sections where I had to spend days trying to understand after being taught in class” (Lulu. Written, 29). She further reflects that, “I had times where I didn’t fully understand some sections and that made me feel very miserable and not want to have Maths and not want Maths periods to happen and cause me to panic” (Lulu. Written, 30).

In the past, Lulu explains that, “I get lazy at times and I feel like maths needs your full-on attention” (Lulu. Spoken, 20) but presently she portrays a picture of a confident mathematics learner. She explains that “in Grade 4 I really enjoyed algebra and all the other kinds of stuff since it was my first time experiencing those types of maths, it was like a shift from Grade 1, 2, 3 to Grade 4 so I found it interesting and I writes exams on the maths, which was also fine” (Lulu. Spoken, 5), and “in Grade 5 pretty much the same thing till Grade 6” (Lulu. Spoken, 6). Her alignment in high school mathematics can be credited to one of her mathematics teachers as she chronicles that, “... in Grade 8 I really enjoyed maths because the teacher that taught maths was very enthusiastic and she made it fun in many ways...” (Lulu. Spoken, 8). Furthermore, “in Grade 9 it wasn’t really difficult in a way because we could understand what was being taught” (Lulu. Spoken, 11).

Lulu also relates another side of her that struggled with alignment in mathematical concepts:

And then we were introduced to other chapters in maths and then the part that I really struggled with was analytical geometry. Like congruency and triangles and all that, I struggled a bit then I moved onto Grade 9 and we carried on with the Grade 8 work and then new things were introduced (Lulu. Spoken, 9-10).

The difficult episodes in her mathematical journey prompted her not to imagine herself doing mathematics related courses in future, as she argues that mathematics is “a choice I’m not considering going to (do) that side because I feel like it’s going to challenge me a like a lot, and I’m not like, I get lazy at times and I feel like maths needs your full on attention” (Lulu. Spoken, 20).

### *Lulu's narrative of her engagement in mathematics*

Lulu's written story shows that her participation in mathematical activities was high. She narrates that: "My journey of mathematics has been one interesting, fascinating and SURELY CHALLENGING (emphasis original) route" (Lulu. Written, 1). She mentions some of the activities that interested and fascinated her in the past:

I remember where we would also count apples, bananas etc. We would get so easy tests on Bonds which were the times tables and we would only get tested on one thing at a time, in other words one maths section at a time. I also participated in the Maths Club since I really enjoyed Maths at school (Lulu. Written, 4-6).

In the after school mathematics clubs, she points out that, "I was so active, and I would really look forward to Maths club every week since we would play Mathematical games and get strategies on how to solve problems" (Lulu. Written, 7).

Her active engagement in mathematics continued into the IP, where she relates that:

Then came grade four, the intermediate phase where things started being real. We were introduced to factorising, simple algebra etc. I really enjoyed finding Highest Common Factors and lowest common multiples. Maths in grade four went pretty well since I had a good foundation from my previous preparatory school. Then came grade seven where we got into deeper algebra (Lulu. Written, 9-14).

She reiterates her active participation in mathematics:, "I understood what was going on in class and I was very engaged (Lulu. Written, 17). I would feel very eager to have a maths period" (Lulu. Written, 19).

Lulu further reflects about her old and caring high school Mathematics teacher that:

The following year in grade 9, I was taught maths by an old and caring teacher. She clearly explained maths concepts and I would get and understand the work easily. Every Maths class I would look forward to what she was going to teach. She would show us solutions to the problems which when I saw, I would be like "Oh Wow!". She made us stretch our minds and I would easily be able to apply concepts to given problems and be able to solve them (Lulu. Written, 20-24).

Although she largely explains successful participation in mathematics in the different landscapes of practice that she passed through, she also highlights some episodes of non-active engagement that:

There were times when I would be so lost in class and even battle in assignments. And in grade seven algebra was a bit of a problem in some sections where there were algebraic fractions, there my interest in Maths was quiet [sic] very low (Lulu. Written, 15-16).

She further narrates her present disalignment in mathematics, that "I had times where I didn't fully understand some sections and that made me feel very miserable and not want to have Maths and not want Maths periods to happen and cause me to panic" (Lulu. Written, 30).



Lulu's spoken narrative presented a learner who was deeply engaged in mathematics activities from primary school to high school and in the after school mathematics club. She expounds that in the past, mathematics "was like actually fun and all, because it wasn't like, I didn't really have to apply much knowledge to solve the sums and that stuff, because it was just simple maths; ok 1 plus 1 and then also using pictures to like work out sums" (Lulu. Spoken, 1). She continues to describe her present participation in mathematics:

...when I got to high school, in Grade 8 I really enjoyed maths because the teacher that taught maths was very enthusiastic and she made it fun in many ways like involving games and stuff in class even though we were in high school, she involved games and then she made us do challenges, we would challenge each other in class for prizes and stuff, so it made it pretty cool (Lulu. Spoken, 8).

Her participation in the subject was further enhanced by the *enthusiastic* mathematics teacher in Grade 9. She describes the period as "also nice because the teacher who taught maths was also very enthusiastic, we could understand what she was teaching, so, in Grade 9 it wasn't really difficult in a way because we could understand what was being taught" (Lulu. Spoken, 11).

However, she recounts that the situation changed when they were moved to a different teacher:

...then in Grade 10, no Grade 9 we moved to another teacher and she was very fast and maths isn't like an easy subject, you have to practice and all, so it isn't nice when a teacher, just like fast forwards through the things and you just there, because you still have to practice at home and you can't practice if you don't understand what you were taught in class (Lulu. Spoken, 13).

The new teacher affected Lulu's alignment and participation because her pacing of the lessons was too fast for her to understand the various mathematical concepts:

...in Grade 9 we struggled with the maths exam, yah the external exam because I feel like in Grade 9 we were taught well, so we could apply the knowledge we have on other things, I'm still in Grade 9, so then we struggled with the exams because we moved to another teacher and I wasn't as flexible of whatever if that's how I can put it (Lulu. Spoken, 15).

She spells out that the period of non-successful engagement in mathematics did not last long and also did not affect Lulu's love and understanding of mathematics as she reflects that, "... in Grade 10, I have a new maths teacher, and I also understand things..." (Lulu. Spoken, 15).

#### **5.2.4.2 Lulu's narrative and modes of belonging**

##### *Engagement*

Like most elementary school learners, Lulu enjoyed her FP years, where she describes her involvement in mutual processes of negotiation of meaning (Wenger, 1998) in the past as interesting and fascinating. She narrates that mathematics was presented:

From the easy and simple ... sums, to the times tables which we had to learn in pre-primary which is from grade 1 to 3. I would just simply and easily get an answer by using my fingers to add and subtract answers by using my fingers to add and subtract from the given sums (Lulu. Written, 2-3).

Engagement in mathematical activities was fascinating because they used manipulatives in the explanation of the different concepts.

She continued to engage successfully in mathematics in the past where she explains that, “There I was so active and I would really look forward to Maths club every week since we would play Mathematical games and get strategies on how to solve problems” (Lulu. Written, 7).

Presently, mathematics continues to be interesting for her as she narrates that:

...when I got to high school, in Grade 8 I really enjoyed maths because the teacher that taught maths was very enthusiastic and she made it fun in many ways like involving games and stuff in class even though we were in high school, she involved games and then she made us do challenges, we would challenge each other in class for prizes and stuff, so it made it pretty cool (Lulu. Spoken, 8).

Her engagement in mathematics continues and she chose Mathematics post the compulsory schooling stage, where she explains that, “in grade 10 Maths is not AS FUN as the lower grades since it is more challenging, developed and requires a lot (of) knowledge and thinking” (Lulu. Written, 31). Although she still narrates active engagement, she points out that there “are sections which when you are introduced to, you easily understand but there are sections where I had to spend days trying to understand after being taught in class” (Lulu. Written, 29).

Regardless of the challenges in the mathematics trajectory from when she started primary school to now, Lulu maintains that she enjoys “Maths because I learn strategies and it stretches my brain and makes me able to tackle problems” (Lulu. Written, 33).

### Alignment

Lulu narrates successful alignment with some mathematical concepts that many learners complain about in the past, for example: “In Grade 4 I really enjoyed algebra and all the other kinds of stuff since it was my first time experiencing those types of maths, it was like a shift from Grade 1, 2, 3 to grade 4 so I found it interesting and I wrote exams on the maths, which was also fine” (Lulu. Spoken, 5). She further states that, “I really enjoyed finding Highest Common Factors and lowest common multiples” (Lulu. Written, 11).

She however narrates episodes where she was disaligned and experienced failure to successfully engage in mathematics and disinterest for example, “in grade seven algebra was a

bit of a problem in some sections where there were algebraic fractions, there my interest in Maths was very low...” (Lulu. Written, 16).

In high school, she recounts that she has intermittent successful engagement in mathematics because her teacher “clearly explained maths concepts and I would get and understand the work easily” (Lulu. Written, 21), however: “There are sections which when you are introduced to, you easily understand but there are sections where I had to spend days trying to understand after being taught in class” (Lulu. Written, 29). She further points out in her written story that “the part that I really struggled with (was) analytical geometry” (Lulu. Spoken, 9). Lulu’s alignment with mathematics is problematic but she continues her engagement with the subject, and she chose Mathematics post the compulsory schooling stage.

### *Imagination*

Lulu reflects that: “Maths in grade four went pretty well since I had a good foundation from my previous preparatory school” (Lulu. Written, 12). The ‘good foundation’ probably made her “feel very eager to have a maths period” (Lulu. Written, 19) because the subject was “MIND BLOWING” (Lulu. Written, 26). She also explains that, “I understood what was going on in class and I was very engaged (Lulu. Written, 17), hence Mathematics “in Grade 9 for me was very easy and enjoyable” (Lulu. Written, 25). She further chose to do mathematics “until Grade 12” (Lulu. Spoken, 19) though she reflects that, post high school: “It’s a choice I’m not considering going to that side because I feel like it’s going to challenge me like a lot, and I’m not like, I get lazy at times and I feel like maths needs your full on attention” (Lulu. Spoken, 20).

Although Lulu has positive reflections of mathematics, she reflects that: “There were times when I would be so lost in class and even battle in assignments” (Lulu. Written, 15). She also chronicles “times where I didn’t fully understand some sections and that made me feel very miserable and not want to have Maths and not want Maths periods to happen and cause me to panic” (Lulu. Written, 30).

### ***5.2.4.3 Summarising Lulu’s identity stories***

Lulu’s narrative about herself reveals that her identity of confidence and active engagement in mathematics in the past resulted from the easy and fun mathematical activities that she actively participated in. Her identity of enjoyment in mathematics and the activities at the after school mathematical club likely increased her alignment and engagement in the subject. In addition, she positions herself as a learner whose enjoyment of mathematics is born out of some of her

teachers' passion and enthusiasm about their work. Lulu narrates that some of her teachers tried to make the subject fun in many ways and illuminate that mathematics is not really difficult and any learner including Lulu can understand and become a competent mathematics learner.

She also tells a story of when she did not fully understand some concepts and that made her feel very miserable and not want to engage in mathematical activities anymore. Lulu positions herself as a learner who values external assistance and appreciates the importance of seeking for assistance from more knowledgeable people in the landscape of practice.

Her identity of love for mathematics shifts and dissipates when her new teacher paced the lessons too fast and Lulu began to conceptualise mathematics as a difficult subject for her.

Her imagined trajectory of her lifelong mathematics engagement ends at Grade 12 as Lulu relates her fears that mathematics would challenge her in future so she decides she would not do it post Grade 12.

### 5.2.5 Akhona: Narrative

The thematic narratives that largely feature in Akhona's written and spoken stories describe her enjoyment of mathematics in the FP (7 utterances, TN7-FP), the IP (7 utterances, TN7-IP), and in high school (8 utterances, TN7-HS). She further describes in her mathematics stories (1 utterance, TN10) how one of her primary school teachers (3 utterances, TN1) and the after school club coordinator positively influenced her engagement in mathematics (2 utterances, TN2). However, she points out that one of her high school teachers (1 utterance, TN3) was not supportive and did not explain mathematics concepts clearly. She also narrates how she appreciated external assistance (1 utterance, TN5) and successfully participated in the after school mathematics clubs (11 utterances, TN6).

In addition, Akhona relates how mathematics was hard in the IP (1 utterance, TN11-IP) and high school (8 utterances, TN11-HS) and how she managed to stay focused and decided to continue doing mathematics post the compulsory schooling stage, but does not mention the gatekeeper effect (TN9) of the subject or whether the subject was difficult in FP (TN11-FP).

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Akhona's written and spoken stories.

Table 5.6 Akhona's narrative

| Written Story                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Narratives about the nature of mathematics                                                                                                                                                                                       | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                                                                                                                                                                                          | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                        |
| <p>13. In grade 8 maths was starting to be more difficult for me... [TN11-HS] (E)</p> <p>15. When I first arrived in high school this were more complicated. [TN11-HS] (E/I)</p> <p>16. Maths was a lot harder [TN11-HS] (E)</p> | <p>1. When I was first introduced to maths in grade 1, I was not sure that I liked it or not. [TN10b] (I)</p> <p>2. But as the years went by, I started to understand and love mathematics. [TN7-FP] (I)</p> <p>3. In grade 2 I started to get great marks in maths because that's when I was beginning to understand maths. [TN7-FP] (I)</p> <p>4. Whenever I got something wrong in a sum I would get frustrated because I always wanted to get everything right. [TN7-FP] (E)</p> | <p>5. But my father taught me that I should understand I won't get everything right all the time. [TN4] (A)</p> <p>6. The only thing I should do is practise every day. [TN7-FP] (E)</p> <p>7. Then in grade 3 my teacher selected me to be one of the 4 other members in a maths club. [TN6a] (E)</p> <p>8. The clubs were very enjoyable, and there were fun games we played. [TN6a] (E)</p> |

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|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                   | <p>9. (the club coordinator) made us play around with maths and I began to love maths even more. [TN6a, TN2] (E)</p> <p>10. After that I started getting surtificates [sic] for maths. [TN7-IP] (E)</p> <p>13. I'm a slow learner (E)</p> <p>16. ...I taught myself to work hard and practice every day. [TN7-HS] (E)</p> | <p>9. [(the club coordinator) <u>made us play around with maths and I began to love maths even more*</u>]. [TN6a, TN2] (E)</p> <p>11. In grade 6 we were given the bad news that maths club will be no more. [TN6b] (E)</p> <p>12. Those were not the greatest things we had ever had. [TN6b] (I)</p> <p>13. [<u>In grade 8 maths was starting to be more difficult for me*</u>] because [<u>I'm a slow learner*</u>] and my teacher did not want to always explain to me. [TN11-HS, TN3b] (E)</p> <p>14. But I tryed [sic] my best to pass and so I did. [TN7-HS] (E)</p> <p>15. [<u>When I first arrived in high school this (maths) were more complicated*</u>]. [TN11-HS] (I)</p> <p>16. [<u>Maths was a lot harder</u>] than before but [<u>I taught myself to work hard and practice every day*</u>]. [TN11-HS, TN7-HS] (E)</p> <p>17. And now I get great marks, and Maths club really helped me in Mathematics a lot. [TN7-HS, TN6a] (I)</p> <p>18. We thank you for everything [TN5] (I)</p> |
| <b>Spoken Story: Interview</b>                    |                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Narratives about the nature of mathematics</b> | <b>Narratives about oneself as a maths learner</b>                                                                                                                                                                                                                                                                        | <b>Narratives of engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>4. And then I saw that maths is kind of hard but really challenging but fun at the same time. [TN6a, TN7-IP, TN11-IP] (E)</p> <p>6. [So, when I went on with maths in Grade 5, Grade 6 I did pretty well*] and then when I got to high school it got a bit tough and challenging. [TN7-FP, TN11-HS] (E)</p> <p>6. ...and then when I got to high school it got a bit tough and challenging. [TN11-HS] (E)</p> | <p>1. Well, when I was first introduced in maths in Grade 1, [I liked it but I sometimes couldn't understand the formulas I was given*] but as [I moved from S. Msholozzi Primary to Mountview Primary, my maths teacher made me understand*] and [she explained to me when I got lost and then that's when I first realised that I really liked maths, love it*]. [TN1a, TN7-FP, TN7-FP, TN11-FP] (E/A)</p> <p>1. I liked it, but I sometimes couldn't understand the formulas I was given... [TN11-FP] (E/A)</p> <p>1. she explained to me when I got lost and then that's when I first realised that I really liked maths, love it. [TN1a, TN7-FP] (E/A)</p> <p>5. So, I like it because I like challenges and stuff. [TN10a] (I)</p> <p>6. So, when I went on with maths in Grade 5, Grade 6 I did pretty well. [TN7-IP] (E)</p> <p>7. But I still choose maths in each and every subject I do. [TN7-HS] (E/I)</p> <p>8. I would like to improve very much in maths. [TN7-HS, TN10a] (I)</p> <p>9. I'm doing good but it's not what I actually want, and [I want to do pure maths in Grade 10 because I found out that it's the one I understand*] the maths, maths lit I sometimes get lost in those word solving problems. [TN7-HS] (E)</p> <p>9. I want to do pure maths in Grade 10 because I found out that it's the one I understand. [TN7-HS] (E)</p> | <p>1. I moved from S. Msholozzi Primary to Mountview Primary, my maths teacher made me understand. [TN1a] (E/A)</p> <p>2. So, she involved me in maths club in Grade 3 and then when I got into that club, I really liked it. [TN6a] (E)</p> <p>3. We did some activities that helped me in class too [TN6a] (E/A)</p> |
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[\*] denotes a phrase extracted to be coded additionally elsewhere

#### 5.2.5.1 Akhona's narrative and Solomon's strands

*Akhona's narrative about the nature of mathematics*

Akhona did not describe the nature of mathematics in her primary school in her written narrative story. She describes the present nature of mathematics that “in high school (mathematics) were more complicated” (Akhona. Written, 15). She continues that “maths was starting to be more difficult” (Akhona. Written, 13) and “a lot harder than before” (Akhona. Written, 16).

In the spoken narrative Akhona describes mathematics in the past as “...kind of hard but really challenging but fun at the same time” (Akhona. Spoken, 4). This probably relates to the activities that she was exposed to in the after school mathematics club. As she continues in her mathematics trajectory, she restates the same description of mathematics in high school but this time she drops the descriptor ‘fun’. Her present stories about the nature of mathematics are summed up in her reflection that, “and then when I got to high school it got a bit tough and challenging” (Akhona. Spoken, 6).

#### *Akhona’s narrative of herself as a mathematics learner*

Akhona describes herself as a learner who started to understand and love mathematics in the past when she explains that: “I started to understand and love mathematics (Akhona. Written, 2). In Grade 2 I started to get great marks in maths because that’s when I was beginning to understand maths” (Akhona. Written, 3). She also explains her frustration in the past when she could not solve some mathematical problems when she writes that: “Whenever I got something wrong in a sum I would get frustrated because I always wanted to get everything right” (Akhona. Written, 4).

She recounts that her love for mathematics increased when she joined the after school mathematics club where “(the club coordinator) made us play around with maths and I began to love maths even more (Akhona. Written, 9). After that I started getting surfificates[sic] for maths” (Akhona. Written, 10). The awards in recognition of her mathematical abilities probably pushed her to put more effort in the subject whereupon she explains that, “I taught myself to work hard and practice every day” (Akhona. Written, 16).

Akhona declares her love for mathematics in the past where she recounts that:

when I was first introduced in maths in Grade 1, I liked it but I sometimes couldn’t understand the formulas I was given but as I moved from S. Msholozzi Primary to Mountview Primary, my maths teacher made me understand and she explained to me when I got lost and then that’s when I first realised that I really liked maths, love it (Akhona. Spoken, 1).



Akhona describes herself as a learner who really loved mathematics, hence her assertion that “when I went on with maths in Grade 5, Grade 6 I did pretty well” (Akhona. Spoken, 6). Furthermore, she participated in the classrooms and the after school mathematics club. In fact, she explains that she loved mathematics “because I like challenges” (Akhona. Spoken, 5). This is reflected in her choice to continue doing mathematics in any given context where she presently maintains that: “I still choose maths in each and every subject I do (Akhona. Spoken, 7). I would like to improve very much in maths” (Akhona. Spoken, 8). She also describes her desire to improve very much in mathematics when she reasons that, “I’m doing good but it’s not what I actually want, and I want to do pure maths in grade 10 because I found out that it’s the one I understand, the maths, maths lit I sometimes get lost in those word solving problems” (Akhona. Spoken, 9).

Although Akhona presents herself as a learner with affinity for mathematics, she sometimes describes herself as “a slow learner” (Akhona. Written, 13) who battles with understanding some of the mathematics formulas.

#### *Akhona’s narrative of her engagement in mathematics*

Akhona’s narrative story shows that she was actively engaged in mathematical practices at all times. She explained that, “my father taught me that I should understand (that) I won’t get everything right all the time” (Akhona. Written, 5), but “the only thing I should do is practise every day” (Akhona. Written, 6). She narrates that she continued her participation in mathematical activities when “in grade 3 my teacher selected me to be one of the 4 other members in a maths club (Akhona. Written, 7). The clubs were very enjoyable, and there were fun games we played (Akhona. Written, 8). (The club coordinator) made us play around with maths and I began to love maths even more” (Akhona. Written, 9).

She describes her disappointment at the discontinuation of the after school club: “In grade 6 we were given the bad news that maths club will be no more (Akhona. Written, 11). Those were not the greatest things we had ever had” (Akhona. Written, 12) because the club afforded her the platform to engage more in mathematics.

She explains that although the discontinuation of the SANCP mathematics club disappointed her she tried her best to pass. She writes that: “Maths was a lot harder than before, but I taught myself to work hard and practice every day (Akhona. Written, 16). And now I get great marks, and Maths club really helped me in Mathematics a lot” (Akhona. Written, 17).

Akhona's engagement in mathematics shifted at some point in her mathematics journey as she expounded that: "In grade 8 maths was starting to be more difficult for me because I'm a slow learner" (Akhona. Written, 13). She further explained that the situation was compounded by her teacher who "did not want to always explain to me" (Akhona. Written, 13).

She talked about participation in mathematical activities both in the classroom and in the after school mathematics club. She reflected in her spoken story that her teacher "involved me in maths club in Grade 3 and then when I got into that club, I really like it" (Akhona. Spoken, 2). In the club Akhona explains that: "We did some activities that helped me in class too" (Akhona. Spoken, 3). Her engagement in the different classrooms and the after school mathematics clubs built a confident mathematics learner who later chose to continue doing mathematics post the compulsory schooling stage in Grade 10.

#### ***5.2.5.2 Akhona's narrative and modes of belonging***

##### *Engagement*

Akhona describes the SANCP after school mathematics club as a place where she successfully engaged with mathematics that, "the clubs were very enjoyable, and there were fun games we played" (Akhona. Written, 8). She further describes herself as a learner who "saw that maths is kind of hard but really challenging but fun at the same time" (Akhona. Written, 4).

She enjoyed the SANCP club and describes its discontinuation as bad news in the following excerpt: "In grade 6 we were given the bad news that maths club will be no more" (Akhona. Written, 11).

She later explains that the transition to high school negatively affected her mathematics engagement because in grade 8 maths was starting to be more difficult ... (Akhona. Written, 13) and "more complicated" (Akhona. Written, 15). However, she describes herself as the kind of learner who, "whenever I got something wrong in a sum I would get frustrated because I always wanted to get everything right" (Akhona. Written, 4). Her determination to learn mathematics is shown in her explanation that: "I want to do pure Maths in Grade 10 because I found out that it's the one I understand" (Akhona. Spoken, 9).

##### *Alignment*

Akhona narrates that she was a learner who successfully aligned with mathematics concepts in primary school when she explained that, "I liked it but I sometimes couldn't understand the formulas I was given but as I moved from S. Msholozzi Primary to Mountview Primary, my

maths teacher made me understand and she explained to me when I got lost and then that's when I first realised that I really liked maths, love it" (Akhona. Spoken, 1). Although she failed to comply with mathematics regulations in her first school, her alignment with mathematics regulations shifted when she moved to a different school.

### Imagination

Akhona reflects that, when she "was first introduced to maths in grade 1, I was not sure that I liked it or not (Akhona. Written, 1). But as the years went by, I started to understand and love mathematics" (Akhona. Written, 2). She explains herself as a learner who engaged successfully in mathematics regardless of some challenging episodes along the journey.

She further reflects that when she "first arrived in high school (mathematics was) more complicated" (Akhona. Written, 15), but "I like it because I like challenges and stuff" (Akhona. Spoken, 5). Her identity as a learner who embraces challenges likely spurred her to "choose maths in each and every subject I do" (Akhona. Spoken, 7) and led her to consider choosing mathematics in Grade 10.

#### ***5.2.5.3 Summarising Akhona's identity stories***

Akhona's narrative about herself is as a learner who understands and loves mathematics and always wants to get everything right. She positions herself as a learner who loved mathematics from the time she was in primary school and also as a learner who enjoyed the fun games played at the club as they helped her in the classroom too.

Interestingly, she positions herself as a slow learner who does not understand complicated and difficult mathematics, but she chose to align herself with mathematics post the compulsory schooling stage. While she says she does not understand complicated and difficult mathematics, she prefers Mathematics to Mathematical Literacy and says that she thrives under challenges, embraces the difficult episodes, and works even harder to solve the problems.

She identifies herself as a learner who sometimes does not understand mathematics formulas and abhors teachers who do not explicitly explain to her yet mathematics is a bit tough and challenging in high school.

### 5.2.6 Anathi: Narrative

Anathi narrates high school teacher stories (5 utterances, TN3), where she had positive working relations with her teacher. She also recounts in her mathematics stories (6 utterances, TN 10), her enjoyment in mathematics in FP (5 utterances, TN7-FP), IP (1 utterance, TN7-IP) and high school (2 utterances, TN7-HS). Although most of her narratives chronicle the difficultness of mathematics in the IP (1 utterance, TN11-IP) and high school (9 utterances, TN11-HS), she chooses to continue doing mathematics in Grade10 and beyond (1 utterance, TN16) as she explains that it fosters critical thinking.

Anathi did not include how she related with both her primary school mathematics teachers (TN1) and the club coordinator (TN2), neither does she describe her parent's involvement (TN4) in her mathematics schoolwork.

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Anathi's written and spoken stories.

Table 5.7 Anathi's narrative

| Written Story                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Narratives about the nature of mathematics                                                                                                                                                                                                                                                     | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                                                | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                |
| <p>2. In grade 1, everything was easy, everything came to me easy. [TN7-FP] (E)</p> <p>3. In foundation phase Maths was so easy, it didn't need much thinking. [TN7-FP] (I)</p> <p>4. In intermediate phase (Grade 4-6) some of the equation and the standard became harder. [TN11-IP] (A)</p> | <p>1. It was almost a decade ago when my first love for maths developed [TN7-FP] (I)</p> <p>7. <u>[I had the most difficult time in grade 9*]</u> [TN11-HS] (E/I).</p> <p>8. Everything I learned was painful to me [TN11-HS] (I)</p> <p>10. In grade 10, I told myself, this year is the year where I show my potential. [TN7-HS] (I)</p> | <p>5. We started learning multiplication and division. [TN10a] (E/A)</p> <p>6. What made (made) it fun was the mental maths we used to do with our teacher every morning. [TN7-IP] (E)</p> <p>7. I had the most difficult time in grade 9 [TN11-HS] (E/I)</p> <p>9. I even dropped on my marks, unlike others grade. [TN11-HS] (A)</p> |
| Spoken Story: Interview                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                        |
| Narratives about the nature of mathematics                                                                                                                                                                                                                                                     | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                                                | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                |
| <p>1. Up to now? I can say from Grade 1 it was like easy... [TN7-FP] (E)</p>                                                                                                                                                                                                                   | <p>1. <u>[Up to now I can say from Grade 1 it was like easy*]</u> although I don't really remember if I had the easiest</p>                                                                                                                                                                                                                | <p>2. Because in Grade 3 we were selected to do the maths club, as I was one of the learners and then <u>[I got a certificate</u></p>                                                                                                                                                                                                  |

|                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>4. ...that's a little more difficult than the one you were given as an example. [TN11-HS] (E)</p> <p>8. ...it is a bit difficult... [TN11-HS] (E)</p> | <p>time because I never really struggled. [TN10a, TN7-FP] (E)</p> <p>2. I got a certificate which proven that I was the top student who achieved in maths. [TN10a] (E/A)</p> <p>3. So, I never had a real hard time in the intermediate phase, in primary as a whole. [TN7-IP] (I)</p> <p>5. the teacher has to give me step by step every time and memorise the formula. [TN3a] (A)</p> <p>7. And then in Grade 10 in term one I did really good because I chose pure maths and then I was doing good and <u>I understood the teacher that was teaching me</u>. [TN10a, TN3a] (E)</p> <p>8. Now <u>[it is a bit difficult*]</u> with the different, you get more information on what you already know but then it's like I can't let go of what I already know first and then it's hard to adapt to the new things you are learning in Grade 10. [TN10b, TN11-HS] (E/A)</p> <p>9. That's the whole thing so I'm still adapting to...and memorising the things that I'm learning in Grade 10. [TN7-HS] (I)</p> <p>10. I think it's going to be good for me the way I've developed because maths trains me on how to solve things critically and I think it is going to be good and I will manage. [TN16] (I)</p> | <p><u>which proven that I was the top student who achieved in maths*</u>. [TN6a] (E/A)</p> <p>4. Then what happened in high school is that in Grade 8 and Grade 9, those were the hardest times because you get things and then I don't know if it is because of the subjects you have that you just don't know how to balance them and you don't know how to focus on your maths classes and you don't concentrate on the question that you are given and you don't know how to, if you on an equation and then you don't know how to, don't know how to get it or do it because it's different] and <u>[that's a little more difficult than the one you were given as an example*]</u>. [TN10b, TN11-HS] (E/A)</p> <p>5. So, it was like <u>[the teacher has to give me step by step every time and memorise the formula.*]</u> [TN3a] (A)</p> <p>6. And then in Grade 10, Grade 9 was bad, Grade 9 is the hardest Grade ever, even the exams whatever you try you like it doesn't work. [TN11-HS] (E/A)</p> <p>7. ... I understood the teacher that was teaching me. [TN3] (E)</p> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[\*] denotes a phrase extracted to be coded additionally elsewhere

### 5.2.6.1 Anathi's narrative and Solomon's strands

*Anathi's narrative about the nature of mathematics*

Anathi writes that in the past, mathematics “was easy, everything came to me easy” (Anathi. Written, 2). She adds that she found that “foundation phase Maths was so easy, it didn’t need much thinking” (Anathi. Written, 3).

Her narrative about the nature of mathematics shifted in the IP as “some of the equation and the standard became harder” (Anathi. Written, 4). She explains that the examples that the teacher and the class demonstrated on the chalkboard were usually less difficult than the work that the teacher asked them to do individually, which was “...a little more difficult than the one you were given as an example” (Anathi. Spoken, 4).

She explained that she was a learner who views mathematics as “a bit difficult with the different, you get more information on what you already know but then it’s like I can’t let go of what I already know first and then it’s hard to adapt to the new things you are learning in grade 10” (Anathi. Spoken, 8).

#### *Anathi’s narrative of herself as a maths learner*

Anathi explains that it was “almost a decade ago when my first love for maths developed” (Anathi. Written, 1).

Despite her love for mathematics, she expounds that mathematics was not an easy subject for her in some parts of her journey. She tells of a story when she “had the most difficult time in grade 9” (Anathi. Written, 7) because: “Everything I learned was painful to me” (Anathi. Written, 8). Although she sometimes faced challenging episodes in her mathematics journey, she resolved that grade 10 was “the year where I show my potential” (Anathi. Written, 10).

Under the section on stories about oneself as a mathematics learner, Anathi explains that, in the past, mathematics “was like easy although I don’t really remember if I had the easiest time because I never really struggled” (Anathi. Written, 1). She describes herself as a learner who did not struggle with primary school mathematics. Anathi perceives herself as a potential participant in mathematics as early as the FP. She reflects that, “I never had a real hard time in the intermediate phase, in primary as a whole” (Anathi. Spoken, 3).

It was only in high school that she admitted that, “...Grade 9 was bad, Grade 9 is the hardest grade ever, even the exams whatever you try you like it doesn’t work” (Anathi. Spoken, 6). She further tells stories of difficulties when she explains that in high school “... it is a bit difficult with the different, you get more information on what you already know but then it’s

like I can't let go of what I already know first and then it's hard to adapt to the new things you are learning ..." (Anathi. Spoken, 8).

She explains that her confidence as a potential learner in mathematics was revived in Grade 10 when "...in term one I did really good because I chose pure maths and then I was doing good and I understood the teacher that was teaching me" (Anathi. Spoken, 7). She also managed to adapt and memorise "the things that I'm learning in Grade 10" (Anathi. Spoken, 9).

Akhona imagines that in future mathematics is "going to be good for me the way I've developed because maths trains me on how to solve things critically and I think it is going to be good and I will manage" (Anathi. Spoken, 10).

#### *Anathi's narrative of her engagement in mathematics*

Anathi writes that learning multiplication and division was made fun by "the mental maths we used to do with our teacher every morning" (Anathi. Written, 6). However, she explains that she is the learner whose engagement in mathematics was not always fun as she "had the most difficult time in grade 9" (Anathi. Written, 7) where she "even dropped on my marks, unlike others' grades" (Anathi. Written, 9).

Anathi describes herself as a learner who actively and successfully engaged in mathematics from primary to high school and through her period in the after school mathematics club when she states that, "... in Grade 3 we were selected to do the maths club, as I was one of the learners and then I got a certificate which proven that I was the top student who achieved in maths" (Anathi. Spoken, 2).

She explains that her engagement in mathematics was not only limited to successful episodes in the landscapes of practise, but:

...what happened in high school is that in Grade 8 and Grade 9, those were the hardest times because you get things and then I don't know if it is because of the subjects you have that you just don't know how to balance them and you don't know how to focus on your maths classes and you don't concentrate on the question that you are given and you don't know how to, if you on an equation and then you don't know how, don't know how to get it or do it because its different and that's a little more difficult than the one you were given as an example (Anathi. Spoken, 4).

Anathi reveals that successful engagement was limited in the early years of high school, but the situation evolved in Grade 10 where she decided to choose to continue studying mathematics. Her choice seems to have been influenced by her teacher in her explanation that: "So, it was like the teacher has to give me step by step every time and memorise the formula" (Anathi. Spoken, 5) and "... in Grade 10 in term one I did really good because I chose pure

maths and then I was doing good and I understood the teacher that was teaching me” (Anathi. Spoken, 7).

### ***5.2.6.2 Anathi’s narrative and modes of belonging***

#### *Engagement*

Anathi writes that in FP “everything was easy, everything came to me easy” (Anathi. Written, 2) and mathematics “didn’t need much thinking” (Anathi. Written, 3). She explains that she enjoyed some mathematical activities such as “mental maths we used to do with our teacher every morning” (Anathi. Written, 6).

Anathi reveals that, although mathematics started becoming a bit difficult in the IP where they were “learning multiplication and division” (Anathi. Written, 5), she “never had a real hard time in the intermediate phase, in primary as a whole” (Anathi. Written, 3).

In high school, everything changed; she expounds that in the early years everything she “learned was painful to me” (Anathi. Written, 8), she reiterates that:

Then what happened in high school is that in Grade 8 and Grade 9, those were the hardest times because you get things and then I don’t know if it is because of the subjects you have that you just don’t know how to balance them and you don’t know how to focus on your maths classes and you don’t concentrate on the question that you are given and you don’t know how to, if you on an equation and then you don’t know how to, don’t know how to get it or do it because its [sic] different and that’s a little more difficult than the one you were given as an example” (Anathi. Spoken, 4).

Anathi explains that she was the learner who found that mathematics was difficulty in Grade 8 and 9, but went on to choose to continue doing mathematics in Grade 10 because she thinks that “maths trains me on how to solve things critically and I think it is going to be good and I will manage” (Anathi. Spoken, 10).

#### *Alignment*

Anathi begins by illuminating how she managed to coordinate mathematical activities to fit within broader mathematical structures and successfully engage in mathematics in the FP where she narrates that: “I got a certificate which proven that I was the top student who achieved in maths” (Anathi. Spoken, 2). She further reveals that her alignment in high school was due to the scaffolding she received from the teacher who “has to give me step by step every time” and her ability to “memorise the formula” (Anathi. Spoken, 5).

She also discusses moments of disalignment that, “in intermediate phase (Grade 4-6) some of the equation and the standard became harder” (Anathi. Written, 4), and later in high school, “I



even dropped on my marks, unlike others grade” (Anathi. Written, 9). The challenges continued in Grade 10 where she had chosen Mathematics: “Now it is a bit difficult with the different, you get more information on what you already know but then it’s like I can’t let go of what I already know first and then it’s hard to adapt to the new things you are learning in Grade 10” (Anathi. Spoken, 8).

### *Imagination*

Anathi reminisces back to “almost a decade ago when my first love for maths developed” (Anathi. Written, 1) because in “foundation phase Maths was so easy, it didn’t need much thinking” (Anathi. Written. 3). In fact, she does not narrate challenges in the conceptualisation of mathematics in primary school.

She presently imagines mathematics as giving her “the most difficult time in grade 9” (Anathi. Written, 7) as what she learned was “painful to me (Anathi. Written, 8). That’s the whole thing so I’m still adapting to...and memorising the things that I’m learning in Grade 10” (Anathi. Spoken, 9). She explains that she is the learner who found that her mathematics journey evolved from easy to comprehend mathematics in the past to difficult mathematics now in high school. However, she still imagines that “it’s going to be good for me the way I’ve developed because maths trains me on how to solve things critically and I think it is going to be good and I will manage” (Anathi. Spoken, 10).

### **5.2.6.3 Summarising Anathi’s identity stories**

Anathi stories herself as a learner who used to love and enjoy mathematics because she never struggled with it in the past. She stories herself as a learner who found mathematics shifting and becoming painful to learn, as it had more difficult episodes in high school. She positions herself as a learner who finds examinations and work in Grade 9 and 10 as the hardest ever. Anathi tells a story of herself when she had difficulties in letting go of old information or mathematical skills from primary school and the after school mathematics club when she receives new strategies and formulas in high school.

She positions herself as a learner with an identity of determination to pass Mathematics in Grade 10, where she explains that she understands the teacher that now teaches her.

She imagines the trajectory of her lifelong mathematics journey is as a learner who conceptualises that mathematics is important because it trains her on how to solve things critically.

### 5.2.7 Cebisa: Narrative

Cebisa's mathematics stories (22 utterances, TN10) describe among other things, her enjoyment in the after school mathematics club (7 utterances, TN6), in the FP (13 utterances, TN7-FP), IP (4 utterances, TN7-IP) and in high school (12 utterances, TN7-HS). The enjoyment probably resulted from good relations with her primary school teachers (1 utterance, TN1), the club coordinator (3 utterances, TN2) and the high school teachers (2 utterances, TN3). Despite the fact that she received external assistance (2 utterances, TN5), she does not mention whether her parents were involved in her schoolwork (TN4).

Cebisa gives great detail in how and when she encountered obstacles in mathematics practice in the IP (13 utterances, TN11-IP) and the high school (19 utterances, TN11-HS).

Regardless of the explicit declaration of her undying love for mathematics, Cebisa does not imagine a future of lifelong mathematics learning (2 utterances, TN16) yet, neither does she imagine it as a gatekeeper (TN9), opting to make a decision about that at some other time.

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Cebisa's written and spoken stories.

Table 5.8 Cebisa's narrative

| <b>Written Narrative</b>                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Narratives about the nature of mathematics</b>                                                                                                                                                                                                                          | <b>Narratives about oneself as a maths learner</b>                                                                                                                                                                                                                                                                                                                                                                        | <b>Narratives of engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                           |
| <p>3. Maths then was extremely easy and [it fascinated me so much (well it still does)*.] [TN7-FP] (I)</p> <p>8. grade 6 that's when maths started being a little bit challenging. [TN11-IP] (E)</p> <p>14. (This is when my interest in maths decreased because Maths</p> | <p>3. it fascinated me so much (well it still does). [TN7-FP] (I)</p> <p>7. Maths club had really set a good foundation for me and that's when I realised that I have a love for numbers. [TN7-FP, TN6a] (A)</p> <p>10. I was really overwhelmed with the amount of difficulty as compared to primary. [TN11-HS] (E/A)</p> <p>14. This is when my interest in maths decreased because Maths was heavy. [TN11-HS] (E).</p> | <p>1. My mathematics story so far has been an exciting, challenging and fascinating rollercoaster. [TN10a] (I)</p> <p>2. It all started at a grade 1 class in North-End Prep. (E)</p> <p>4. It all started with the easy 1+1 grade 1-2 questions of which I aced. [TN7-FP] (E)</p> <p>5. It then levelled up a bit in grade 3. [TN7-FP] (A)</p> <p>6. Grades 3 was my most exciting maths year because that when I started Maths Club with (the club</p> |

|                                                                                                                  |                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>was heavy). [TN11-IP] (E)</p> <p>17. Pure Maths is no child's play and is very challenging. [TN11-IP] (E)</p> | <p>15. ...I could still bag some As of which encouraged me to choose Pure Maths. [TN7-HS, TN10] (E)</p> <p>18. Sometimes I get so frustrated because I do not understand the new work. [TN11-HS] (E)</p> <p>19. My maths journey hasn't been easy at all but through it all I still love Maths. [TN7-HS, TN11-HS] (I)</p> | <p>coordinator). [TN7-FP, TN6a] (E/I)</p> <p>8. Grade 4-5 maths was a bit manageable but when I got to <u>[grade 6 that's when maths started being a little bit challenging*]</u>. [TN7-IP, TN10b, TN11-IP] (E)</p> <p>9. But I battled my way through grade 6 and 7 maths and then I got to high school and that's when maths took a real turn. [TN7-IP, TN10, TN11-IP] (E)</p> <p>10. First few weeks in grade 8 Maths, <u>[I was really overwhelmed with the amount of difficulty as compared to primary*]</u> [TN10, TN11-HS] (E/A)</p> <p>11. New concepts had been introduced but I still managed to bag my As. [TN7-IP] (E/A)</p> <p>12. Then I got to grade 9 and that's when maths started being real. [TN11-HS] (E)</p> <p>13. Here we were introduced to graphs and many other difficult concepts of which challenged me a lot. [TN11-HS] (E/A)</p> <p>14. <u>[(This is when my interest in maths decreased because Maths was heavy)*]</u> [TN11-HS] (E)</p> <p>15. Because I had a wonderful teacher who would clearly explain the work <u>[I could still bag some As of which encouraged me to choose Pure Maths*]</u>. [TN7-HS, TN3a, TN10] (E).</p> <p>15. Grade 10 Maths! All I can say about grade 10 is wow! [TN11-HS] (E/I)</p> |
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| <b>Spoken Story: Interview</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Narratives about the nature of mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Narratives about oneself as a maths learner</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Narratives of engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>1. it wasn't really intense it was very easy [TN7-FP] (E)</p> <p>2. It was all straight forward, yeah. [TN7-FP] (A)</p> <p>3. ...but it was really fine. [TN7-FP] (E)</p> <p>8. And then Grade 4 maths was challenging, because maths club was over then, as she left. [TN6b, TN11-IP] (E/I)</p> <p>10. And then Grade 4 maths was a bit tricky, cause I'm from Grade 3 obviously, and but it was fine, it was a bit challenging. [TN11-IP] (E/I)</p> <p>15. yeoh, Grade 7 maths, yeoh, yeoh, it was challenging. [TN11-IP] (I)</p> <p>17. It was really preparing me for</p> | <p>4. Grade 3, um, that's when I realised I loved maths, Grade 3, that's when I realised I loved numbers specifically, and <u>[that's when I started maths club, Grade 3 right.*]</u> [TN7-FP, TN6a] (E/I)</p> <p>6. And she really made my love for maths increase each day. [TN2, TN7-IP] (I)</p> <p>11. Grade 5, was ok because I had a good maths teacher, so she explained everything really well. [TN1a, TN7-IP] (E/I)</p> <p>12. I loved, I think that's when we were introduced to, no, Grade 6 was when were introduced to algebra, I'm not sure. [TN10a] (I)</p> <p>13. I absolutely hated algebra, yeoh I hated algebra, yes. [TN11-IP] (I/A)</p> <p>14. Another topic I hated, I think we did probability in Grade 6 as well, I'm not sure. [TN11-IP] (I/A)</p> <p>19. I could say I enjoyed it, maths has been my favourite subject since Grade 3 like I said. [TN10a, TN7-FP] (I/A).</p> <p>23. The equations, just everything I loved Grade 9 maths, even though it was really hard, I loved it, loved loved loved. [TN10a, TN11-HS, TN7-HS] (I/A).</p> | <p>1. Um, so in Grade 1, obviously it was the first time we were introduced to numbers and yeah, <u>[it wasn't really intense it was very easy*]</u>, we had shapes, we had pictures, it was so easy that I didn't really need to think about it. [TN7-FP] (E)</p> <p>3. Grade 2 was a step higher obviously, because I'm from Grade 1, <u>[but it was really fine*]</u>. [TN7-FP] (E)</p> <p>4. ...that's when I started maths club, Grade 3 right [TN6a] (E)</p> <p>5. Yes, with (the club coordinator), if I remember properly, yes. [TN2] (E)</p> <p>7. We had math club once a week it was Wednesdays, yeah, and it was really nice, she also increased how, like my thinking, she just improved my skills. [TN2, TN6a, TN7-IP] (E)</p> <p>16. I could see that ok now I'm going to high school. (I)</p> <p>18. It had shapes, it had algebra, it had solving for x, it had everything, yeah it had a lot, <u>[so it was really hard to wrap my head around it*]</u>. [TN10b, TN11-IP] (E/A)</p> <p>20. Um Grade 8 maths, yeah, hai ke, high school, it came with a bang, because I didn't expect it,</p> |

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| <p>high school, it was so hard I don't know. [TN11-IP, TN10b] (I)</p> <p>18. so it was really hard to wrap my head around it. [TN11-IP] (E/A)</p> <p>20. Um Grade 8 maths, yeoh, hai ke, high school, it came with a bang, because I didn't expect it, like it was, the amount of work and the intensity, because it was both hard and a lot. [TN11-HS] (E)</p> <p>21. Grade 8 maths was interesting... [TN7-HS] (E/I)</p> <p>24. it's really hard [TN11-HS] (E)</p> <p>28. Yah Grade 10 maths is nice. [TN10a, TN7-HS] (E)</p> <p>31. ....as I go up its getting harder and harder... [TN11-HS] (E)</p> | <p>24. Grade 10 maths, ok, Grade 10 maths I don't know where I stand, ok I do, because I do enjoy it but [it's really hard*], sometimes I get to a point where I'm just like I want to cry, [sometimes in class I'll be like yeoh, my teacher will be explaining, explaining, explaining and I'll be like I don't get a thing*]. [TN10b, TN7-HS, TN11-HS, TN3b] (E)</p> <p>29. I enjoy it a lot especially the equations, the quadratic equations, the exponents, yeah exponents are really nice, where they manipulate where you have to change your base, so it's... it's just really nice, it's very nice [TN10a, TN7-HS] (E/A)</p> <p>30. I think I enjoy Grade 10 maths a lot. [TN10a, TN7-HS] (I)</p> <p>31. UM, ok, so I've noticed that [as I go up its getting harder and harder*], so definitely I think it will get harder and harder, but I don't think that my love for maths will decrease. [TN10a, TN16] (I)</p> <p>32. I feel that as it gets more difficult, my love that's when my love will also increase. [TN10a, TN16] (I)</p> <p>33. I really love subjects that make you think, like I love being challenged, so yeah, I think that's why I also love maths, because I love being challenged, I love to think outside the box [TN10a] (E/I)</p> <p>34. I also love having to think and sweat, and think and be like oh my gosh, I can't figure this out but then eventually when I figure it out</p> | <p>like it was, the amount of work and the intensity, because it was both hard and a lot. [TN10b, TN11-HS] (E)</p> <p>21. [Grade 8 maths was interesting*], I really liked a lot of topics we were introduced to such as distributive law, such as the equations, what else, I can't remember well [TN10b, TN7-HS] (I/A)</p> <p>22. But Grade 9, was the year I absolutely loved, Grade 9 maths, especially the graphs, when we were first introduced to the graphs, they were very hard at first but like immediately when I understood how to do the graphs, I absolutely loved graphs and finance, I loved them. [TN10a, TN7-HS] (A/I)</p> <p>24. ...sometimes in class I'll be like yeoh, my teacher will be explaining explaining explaining and I will be like I don't get a thing. [TN3b, TN11-HS] (E/I)</p> <p>25. Especially with the graphs, no trig, trig graphs, yeoh, trigonometry its eish... [TN10b] (A)</p> <p>26. Eish, and the graphs, the functions, exponential graphs, parabola, the hyperbole, those are really tough, and I didn't think surface area, because for the previous months surface area was really easy it was like a breeze, but this year it's just a lot of formulas I have to remember, and yesterday I was writing a test [TN10a, TN11-HS] (E/A)</p> <p>27. And I thought I had remembered all of the formulas and when I got to the test, I was like eish, it was just all over the</p> |
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|--|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
|  | I'm just like so happy, and yah<br>[TN10a, TN7-HS] (E/I)                                                 | place, but I hope I did well in that<br>test. [TN10b, TN11-HS] (I) |
|  | 35. I don't know if I will continue<br>with maths after high school, I'm<br>not sure of that. [TN16] (I) |                                                                    |

[\*] denotes a phrase extracted to be coded additionally elsewhere

### 5.2.7.1 Cebisa's narrative and Solomon's strands

#### *Cebisa's narrative about the nature of mathematics*

Cebisa writes that she found mathematics in early primary “extremely easy and it fascinated me so much (well it still does)” (Cebisa. Written, 3). Later in the IP she explains that, “maths started being a little bit challenging” (Cebisa. Written, 8). The challenging episodes that she described went on to affect her interest in mathematics, as explained in the written story: “This is when my interest in maths decreased because Maths was heavy” (Cebisa. Written, 14). In Grade 10 she reports that she found that: “Pure Maths is no child's play and is very challenging” (Cebisa. Written, 17).

Cebisa explained that she was a learner who described mathematics as easy, straightforward, interesting, and declares her affinity for the subject. She relates that “it wasn't really intense it was very easy, we had shapes, we had pictures, it was so easy that I didn't really need to think about it” (Cebisa. Spoken, 1). She proceeds to then describe Grade 8 and 10 mathematics as interesting and nice respectively.

To a large extent, Cebisa was the learner who was disaligned with mathematics. She expounds that her problems started in the IP where “Grade 4 maths was challenging...” (Cebisa. Spoken, 8) and “... a bit tricky” (Cebisa. Spoken, 10). The trend escalated in Grade 7 where she explains that she believed that the challenges were a harbinger of what she was going to face in high school: “I could see that ok now I'm going to high school (Cebisa. Spoken, 16). It was really preparing me for high school, it was so hard I don't know” (Cebisa. Spoken, 17). She imagined that the subject had nothing but difficulties and challenges as: “It had shapes, it had algebra, it had solving for x, it had everything, yeoh it had a lot, so it was really hard to wrap my head around it” (Cebisa. Spoken, 18). The difficulties continued when she started high school. She relates that, “Grade 8 maths, high school, it came with a bang, because I didn't expect it, like it was, the amount of work and the intensity, because it was both hard and a lot” (Cebisa. Spoken, 20).

Although she found that the amount of work and intensity in subjects increased in high school, this did not diminish her affinity for mathematics. She therefore declared that, “the equations, just everything I loved Grade 9 maths, even though it was really hard, I loved it, loved, loved, loved” (Cebisa. Spoken, 23). She imagines that as she goes up, mathematics will get “harder and harder, so definitely I think it will get harder and harder, but I don’t think that my love for maths will decrease” (Cebisa. Spoken, 31).

*Cebisa’s narrative about herself as a maths learner*

Cebisa describes herself as a learner who loved mathematics regardless of the challenges that she encountered in her mathematics journey. She explained herself as a learner who is fascinated by mathematics. In addition, she writes that: “My maths journey hasn’t been easy at all but through it all I still love Maths” (Cebisa. Written, 19). She values the after school mathematics club and explains that it “had really set a good foundation for me and that’s when I realised that I have a love for numbers” (Cebisa. Written, 7). In grade 10, Cebisa writes that she still believed in her potential to pursue mathematics and where she “could still bag some As” and this encouraged her “to choose Pure Maths” (Cebisa. Written, 15).

Although Cebisa described herself as a learner who loved mathematics, she writes that: “Sometimes I get so frustrated because I do not understand the new work” (Cebisa. Written, 18). She recounts that the frustration grew when she compared mathematics work in primary to high school where she “was really overwhelmed with the amount of difficulty as compared to primary” (Cebisa. Written, 10). She continues that: “This is when my interest in maths decreased because Maths was heavy” (Cebisa. Written, 14).

Cebisa presented herself as a largely good mathematics learner who was resilient and endowed with mathematics affinity. Her affinity for mathematics began at the end of FP, when she explained that “I realised I loved maths, Grade 3, that’s when I realised I loved numbers specifically, and that’s when I started maths club...” (Cebisa. Spoken, 4). She credited her love for mathematics to her after school mathematics club facilitator when she explains that “she really made my love for maths increase each day” (Cebisa. Spoken, 6).

Cebisa continued to speak boldly about her love for the subject when she narrates that: “I enjoyed it, maths has been my favourite subject since Grade 3” (Cebisa. Spoken, 19). She explains that even as new and complicated concepts such as equations were introduced, “I loved Grade 9 maths even though it was really hard, I loved it, loved loved loved” (Cebisa. Spoken, 23).

She further exhibits her resilience and quest for challenges in mathematics when she restated in her spoken story that:

I really love subjects that make you think, like I love being challenged, so yah, I think that's why I also love maths, because I love being challenged, I love to think outside the box. I also love having to think and sweat, and think and be like oh my gosh, I can't figure this out but then eventually when I figure it out, I'm just like so happy, and yeah (Cebisa. Spoken, 33-34).

Although Cebisa speaks boldly about her love for mathematics, she points out the episodes that intermittently affected her stories of herself as a mathematics learner, "I absolutely hated algebra, yeoh, I hated algebra, yes. Another topic I hated, I think we did probability in Grade 6 as well, I'm not sure" (Cebisa. Spoken, 13-14). In addition, she did not speak firmly about her imagined future in mathematics as she concluded in her interactive interview that: "I don't know if I will continue with maths after high school, I'm not sure of that" (Cebisa. Spoken, 35).

#### *Cebisa's narrative of her engagement in mathematics*

Cebisa writes that her engagement in mathematics was "an exciting, challenging and fascinating rollercoaster" (Cebisa. Written, 1). She continues to describe her alignment in the FP where engagement involved easy to solve mathematical problems which she aced.

She reports that she was the learner who believed that: "Grades [sic] 3 was my most exciting maths year because that when I started Maths Club" (Cebisa. Written, 6). She proceeds to explain her engagement in Grade 4 and 5 mathematics "was a bit manageable but when I got to grade 6 that's when maths started being a little bit challenging" (Cebisa. Written, 8).

Despite the challenging episodes, Cebisa explains that: I battled my way through grade 6 and 7 maths and then I got to high school and that's when maths took a real turn (Cebisa. Written, 9). First few weeks in grade 8 Maths, I was really overwhelmed with the amount of difficulty as compared to primary (Cebisa. Written, 10). New concepts had been introduced but I still managed to bag my As (Cebisa. Written, 11).

Cebisa recounts that successful engagement in mathematics declined in high school where she reflects that, "I got to grade 9 and that's when maths started being real. Here we were introduced to graphs and many other difficult concepts of which challenged me a lot. This is when my interest in maths decreased because Maths was heavy" (Cebisa. Written, 12-14).

Although mathematics was difficult for her in high school such that she sometimes got "so frustrated because I do not understand the new work" (Cebisa. Written, 18), she pointed out that: "Because I had a wonderful teacher who would clearly explain the work, I could still bag some As of which (this) encouraged me to choose Pure Maths" (Cebisa. Written, 15).



Cebisa explains in the narrative that she enjoyed and participated well in mathematical activities. She reflects on her engagement in the after school mathematics clubs, where she describes the assistance she got from the club coordinator: “We had math club once a week ...and it was really nice, she also increased how, like my thinking, she just improved my skills” (Cebisa. Spoken, 7).

She further describes her engagement in mathematics in high school:

Grade 8 maths was interesting, I really liked a lot of topics we were introduced to such as distributive law, such as the equations, what else, I can't remember well (Cebisa. Spoken, 21). But Grade 9, was the year I absolutely loved, Grade 9 maths, especially the graphs, when we were first introduced to the graphs, they were very hard at first but like immediately when I understood how to do the graphs, I absolutely loved graphs and finance, I loved them (Cebisa. Spoken, 22).

She describes her successful engagement and alignment in mathematics in high school where she relates that: “I enjoy it a lot especially the equations, the quadratic equations, the exponents, yeah exponents are really nice, where they manipulate where you have to change your base, so it's... it's just really nice, it's very nice” (Cebisa. Spoken, 29).

However, her successful participation in mathematics was not without its challenges. Shenarrates the episodes of disalignment and non-participation as follows:

Grade 10 maths, ok, Grade 10 maths I don't know where I stand, ok I do, because I do enjoy it but it's really hard, sometimes I get to a point where I'm just like I want to cry, sometimes in class I'll be like yeoh, my teacher will be explaining explaining explaining and I'll be like I don't get a thing. Especially with the graphs, no trig, trig graphs, yeoh, trigonometry its eish. Eish, and the graphs, the functions, exponential graphs, parabola, the hyperbole, those are really tough, and I didn't think surface area, because for the previous months surface area was really easy it was like a breeze, but this year it's just a lot of formulas I have to remember (Cebisa. Spoken, 24-26).

The episodes of non-participation however did not diminish her love for mathematics.

#### ***5.2.7.2 Cebisa's narrative and modes of belonging***

##### ***Engagement***

Cebisa narrates her successful engagement in mathematics in the past where she relates that: “Grade 3 was my most exciting maths year because that when I started Maths Club with (club coordinators name)” (Cebisa. Written, 6), and that was “when I realised I loved maths, Grade 3, that's when I realised I loved numbers specifically...” (Cebisa. Spoken, 4).

She recounts challenges in her mathematics trajectory where she explains mathematics “was a bit manageable, but when I got to grade 6 that's when maths started being a little bit

challenging” (Cebisa. Written, 8), but she battled her way through primary school, without any major disengagement episodes in her mathematics practice.

According to Cebisa, engagement in mathematics “took a real turn” (Cebisa. Written, 9) during her transition to high school. She relates that the challenges are now overwhelming “as compared to primary” (Cebisa. Written, 10). She continues that, in grade 9 “that’s when maths started being real. (Cebisa. Written, 12) Here we were introduced to graphs and many other difficult concepts of which challenged me a lot” (Cebisa. Written, 13). Additionally, she explains that this is “when my interest in maths decreased because Maths was heavy” (Cebisa. Written, 14) and “sometimes I get so frustrated because I do not understand the new work” (Cebisa. Written, 18).

However, she reports that her motivation to persevere throughout the mathematics can be credited to her “wonderful teacher who would clearly explain the work” and “I could still bag some As” of which this “encouraged me to choose Pure Maths” (Cebisa. Written, 15) post the compulsory schooling stage.

Cebisa chronicles that her mathematics engagement in Grade 10 is challenging but: “I do enjoy it, but it’s really hard, sometimes I get to a point where I’m just like I want to cry, sometimes in class I’ll be like yeoh, my teacher will be explaining, explaining, explaining and I’ll be like I don’t get a thing” (Cebisa. Spoken, 24). She explains that the episodes of disengagement have not disturbed her affinity for mathematics practice and her fluency in its conceptualisation as captured in the quotation that: “I enjoy it a lot especially the equations, the quadratic equations, the exponents, yeah exponents are really nice, where they manipulate where you have to change your base, so it’s... it’s just really nice, it’s very nice” (Cebisa. Spoken, 29).

Overall, Cebisa concludes that: “I really love subjects that make you think, like I love being challenged, so yeah, I think that’s why I also love maths, because I love being challenged, I love to think outside the box” (Cebisa. Spoken, 33).

### *Alignment*

Cebisa recounts that in primary school mathematics was largely “all straight forward” (Cebisa. Spoken, 2), but there were some episodes of disalignment in primary where she “absolutely hated algebra, yeoh I hated algebra” (Cebisa. Spoken, 13). She reiterates in the spoken narrative that algebra “had solving for x, it had everything, yeoh it had a lot, so it was really hard to wrap my head around it” (Cebisa. Spoken, 18). In addition, she relates that another topic that she hated was probability in Grade 6.

She tells a story of further difficulties in establishing herself in high school mathematical practice as follows: “First few weeks in grade 8 Maths, I was really overwhelmed with the amount of difficulty as compared to primary (Cebisa. Written, 10). Here we were introduced to graphs and many other difficult concepts of which challenged me a lot” (Cebisa. Written, 13).

However, the intermittent episodes of disalignment did not diminish her affinity for mathematics as she explains that: “I could say I enjoyed it, maths has been my favourite subject since Grade 3 like I said” (Cebisa. Spoken, 19). She chronicles her affinity for mathematics practice that:

...Grade 9 was the year I absolutely loved, Grade 9 maths, especially the graphs, when we were first introduced to the graphs, they were very hard at first but like immediately when I understood how to do the graphs, I absolutely loved graphs and finance, I loved them.. The equations, just everything I loved Grade 9 maths, even though it was really hard, I loved it, loved loved loved (Cebisa. Spoken, 22-23).

She continues to narrate that in Grade 10: “I enjoy it a lot especially the equations, the quadratic equations, the exponents, yeah exponents are really nice, where they manipulate where you have to change your base, so it’s... it’s just really nice, it’s very nice” (Cebisa. Spoken, 29). Cebisa concludes her narrative about alignment with mathematics practice by pointing out that although: “New concepts had been introduced...I still managed to bag my As” (Cebisa. Written, 11).

### *Imagination*

In the past Cebisa conceptualised that mathematics was “extremely easy and it fascinated me so much (well it still does)” (Cebisa. Written, 3). She further expounded her successful alignment in mathematics practice when she stated that: “I realised I loved maths, grade 3, that’s when I realised I loved numbers specifically, and that’s when I started maths club...” (Cebisa. Written, 4).

Although Cebisa attended the after school mathematics club for a single year, she reports that she felt the impact of its absence in the following year as she explains that, “Grade 4 maths was challenging, because maths club was over then...” (Cebisa. Spoken, 8). Her narrative further reveals that “Grade 4 maths was a bit tricky (and) bit challenging” (Cebisa. Spoken, 10).

Overall, Cebisa relates that her affinity for mathematics persisted from primary to high school. She expounds that her “maths journey hasn’t been easy at all but through it all I still love

Maths” (Cebisa. Spoken, 19). She further amplifies her commitment to mathematics practice when she writes that:

I think I enjoy Grade 10 maths a lot. Um, ok, so I’ve noticed that as I go up its getting harder and harder, so definitely I think it will get harder and harder, but I don’t think that my love for maths will decrease. I feel that as it gets more difficult, my love that’s when my love will also increase. I really love subjects that make you think, like I love being challenged, so yeah, I think that’s why I also love maths, because I love being challenged, I love to think outside the box (Cebisa. Spoken, 30-33).

Despite her present commitment to mathematics, Cebisa does not readily commit to future mathematics engagement. She explains that: “I don’t know if I will continue with maths after high school, I’m not sure of that” (Cebisa. Spoken, 35).

#### ***5.2.5.3 Summarising Cebisa’s identity stories***

Cebisa aligns herself with mathematics as she conceptualises it as easy and fascinating so much. She tells a story of how she loved and enjoyed mathematics in primary school. Cebisa’s narrative about herself is as a learner who states that the after school mathematics club made her love for mathematics increase each day she participated in it. She identifies the after school club as a space that increased her mathematical thinking and improved her mathematics skills.

While she says the after school mathematics club increased her mathematical thinking and improved her mathematics skills, her identity of love for mathematics shifted when mathematics became difficult and challenging when the after school mathematics club discontinued.

Her narrative about herself in high school is as a learner who relates that she was overwhelmed by the amount of difficulty in mathematics compared to primary school mathematics.

She stories herself as a learner who loves mathematics and imagines that as mathematics gets more difficult, her love for it will increase because she thrives under challenging situations that need learners to think outside the box. She identifies herself as a learner who loves to think and sweat, and eventually become happy when she overcomes the challenges.

Cebisa’s imagined trajectory of her lifelong mathematics journey is not clear as she relates that she does not know if she will continue with mathematics post high school.

### 5.2.8 Ayabonga: Narrative

In some of his mathematics stories (12 utterances, TN10), Ayabonga acknowledges the value of external assistance (4 utterances, TN5) and recounts his participation in the after school mathematics club (3 utterances, TN6) in his mathematics journey from primary to high school. He also chronicles narratives of massive enjoyment in mathematics in the FP (7 utterances, TN7-FP), the IP (21 utterances, TN7-IP) and in high school (8 utterances, TN7-HS).

Although Ayabonga narrates massive enjoyment in mathematics practice, he recounts moments when mathematics was hard in the IP (5 utterances, TN11-IP) and high school (8 utterances, TN11-HS). Lastly, he describes his imagination of his future lifelong mathematics learning (3 utterances, TN16).

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Ayabonga's written and spoken stories.

Table 5.9 Ayabonga's narrative

| Written Story                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| Narratives about the nature of mathematics                                                                                                                                                                                                                          | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <p>3. At first math was so fun... [TN7-FP] (E)</p> <p>11. maths is actually a fun subject to do. [TN7-IP] (E)</p> <p>14. So I conclude by saying that in my life maths has been a fun and a challenging subject and also it is my friend. [TN11-HS, TN7-IP] (I)</p> | <p>4. It was then that in Grade 3 teachers saw the potential I have in Mathematics and I was selected to be part of the Maths Club in Primary School. [TN1, TN6a] (E)</p> <p>9. I have love for mathematics [TN7-IP] (E)</p> <p>10. I went to high school in Grade 8 doing the same kind of maths and I was still loving it. [TN7-IP] (E)</p> <p>11. Then I had a chance to look back at my old reports and <u>[I saw that [maths is actually a fun subject to do*] and I was loving it*]</u>. [TN7-IP] (E/I)</p> <p>11. I saw that maths is actually a fun subject to do and I was loving it. [TN7-IP] (E/I)</p> <p>12. <u>[I tried my best to have a good come back and luckily learned other</u></p> | <p>1. I remember the first time that I did mathematics. [TN10a] (I)</p> <p>2. It was in Grade 1, my teacher told me that today we are starting a new thing that we will need to know and learn it for our rest of our lives. [TN10a] (I)</p> <p>3. <u>[At first math was so fun*]</u> because we were like counting apples and stuff then we move to counting (1+1) I loved doing that kind of stuff. [TN10a, TN7-FP] (E)</p> <p>5. I got there and I learned new things and the math in that time was like upgraded, it was not the same as the maths that I was doing in Grade 1. [TN6a, TN10a] (E)</p> |

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|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                             | <p><u>new ways to find an answer e.g new formulars' [sic]*]. [TN7-IP] (E/I)</u></p> <p>13. It was then that I decided to carry on doing Mathematics in Grade 10 and for the rest of my life, because maths is the only subject that I mostly love. [ TN7-IP] (E/I)</p> <p>14. So I conclude by saying that in my life maths has been a fun and a challenging subject and also <u>[it is my friend*] [TN11-HS, TN7-IP] (I)</u></p> <p>14. ...it is my friend <u>[TN7-IP] (I)</u></p> <p>15. #LOVEMATHEMATICS. [TN7-IP] (I)</p> | <p>6. The maths club help me to polish my skills in Maths and I was thought new ways to count or find answers. [TN6a] (A)</p> <p>7. I went throw [sic] the entire Primary, then I got to Grade 7 were we were thought (taught) a new level of mathematics. [TN10a] (A)</p> <p>8. It was then that I thought that maths was going to be hard because we were solving not only number but letters like (x). [TN10a, TN11-IP] (E)</p> <p>9. I tried it and I saw that nothing was difficult at all, it was fun and challenging but that day I saw that <u>[I have love for mathematics*] [TN10a, TN7-IP] (E)</u></p> <p>12. Then in Grade 9 maths was like upgraded to another level because it seemed difficult but I kept going though I fail term 1, <u>[I tried my best to have a good come back and luckily learned other new ways to find an answer e.g. new formulars'[sic]*]. [TN7-IP] (E/I)</u></p> <p>13. <u>[It was then that I decided to carry on doing Mathematics in Grade 10 and for the rest of my life, because maths is the only subject that I mostly love.*] [TN7-IP] (E/I)</u></p> |
| <b>Spoken Story: Interview</b>                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Narratives about the nature of mathematics</b>           | <b>Narratives about oneself as a maths learner</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Narratives of engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 1. ...maths was quite fun and it was easy... [TN7-FP] (E/A) | 3. So it was kind like fun because I understood everything from Grade 1 until Grade 2, then I continued in Grade 3, <u>[then in Grade 3 it was quite challenging because we, they</u>                                                                                                                                                                                                                                                                                                                                         | 1. In Grade 1 my maths story like, in Grade 1 the <u>[maths was quite fun and it was easy*]</u> for me because we were working with simple, simple, simple,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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| <p>3. ...then in Grade 3 it was quite challenging because we, they added like multiplication stuff and everything... [TN11-IP] (A)</p> <p>5. I didn't see any difficulty in maths, Grade 4, Grade 5, it was like fun... [TN7-IP] (E)</p> <p>6. Then Grade 6&amp;7 ah hey, that was the year we got to solve x and stuff, so it was quite difficult for me because I was learning new things.... [TN11-IP] (E/A)</p> <p>13. but in Grade 10 it's quite challenging... [TN11-HS] (I)</p> <p>14. it was quite difficult for me... [TN11-HS] (I)</p> <p>18. In future, ah, this past few weeks I asked my teacher how maths will be in Grade 11 and he didn't even, like <i>beat around the bush</i> he told me straight that it will be hard. [TN3, TN11-HS] (A/I)</p> | <p>added like multiplication stuff and <u>everything*</u>], then [<u>I was quite good at it that I was even picked up to join maths clubs since they saw that my results are excellent in maths*</u>]. [TN7-FP, TN11-FP] (E/A).</p> <p>3. ... I was quite good at it that I was even picked up to join maths clubs since they saw that my results are excellent in maths. [TN7-FP] (E)</p> <p>4. Then I moved on to Grade 4, in Grade 4 I excelled at maths at my primary school [TN7-IP] (E)</p> <p>5. I didn't see any difficulty in maths, Grade 4, Grade 5, it was like fun, [<u>I love maths, every time I get home I practise, now and again*</u>] [TN7-IP] (E/I)</p> <p>5. ...I love maths, every time I get home I practise, now and again. [TN7-IP] (E)</p> <p>6. [<u>Then Grade 6&amp;7 ah hey, that was the year we got to solve x and stuff, so it was quite difficult for me because I was learning new things,*</u>] so I didn't like quiet adjust, but I tried my best and then I knew it, like two months or so like a term then I understood that maths story, and then [<u>I trained myself so that I can learn more so that I can solve more problems*</u>] [TN7-IP, TN11-IP] (E/A/I)</p> <p>6. I trained myself so that I can learn more so that I can solve more problems. [TN7-IP] (E/I)</p> <p>8. It hit me hard, but then I tried my best, and then, Grade 9, that was the year, first term, I failed maths, I was quite disappointed. [TN11-HS] (E/I)</p> <p>10. I trained myself to do those equations and I excelled. [TN5] (A)</p> | <p>how can I put this, simple equations like 1+1, those were the easy stuff for me, so maths was quite fun in Grade 1 [TN7-FP] (E/A)</p> <p>2. Then we moved on in Grade 2 then in Grade 2 they just added a bit of information from the one that we were doing in Grade 1. [TN7-FP] (E/A)</p> <p>5. I love maths, every time I get home I practise, now and again. [TN7-IP] (E)</p> <p>6. Then Grade 6&amp;7 ah hey, that was the year we got to solve x and stuff, so it was quite difficult for me because I was learning new things... [TN11-IP] (E/A)</p> <p>7. Then I got into high school, and then in high school, it hit me hard in Grade 8 at first, because it was my first time doing like other equations, simplifying and factorising. [TN11-HS] (E/A)</p> <p>9. I went to a tutor here at eh in High street, he helped me to, like improve on my results. [TN5] (E)</p> <p>10. He gave me different equations from different schools and previous papers of the exams and then like [I trained myself to do those equations and I excelled]. [TN5] (E/A)</p> <p>11. And then that was the year I was given a form for the subject in Grade 10. (E)</p> <p>15. Then in this term, I am working at my best, I am trying all I can, by all means to pass mathematics but then I quite</p> |
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|  | <p>12. I chose mathematics, pure maths because I saw from my past results that I was good at maths and that I love maths, it's like my passion. [TN7-HS, TN10a] (I)</p> <p>13. Then ah I am still doing mathematics, I love it, <u>[but in Grade 10 it's quite challenging*]</u> because term 1 I did very very well, excellent, like level 7s and everything. [TN7-HS, TN10a] (E)</p> <p>14. In term 2 I dropped because they added like other things and then in term 3 they implemented like new laws, <u>[it was quite difficult for me*]</u>, doing the graphs and then so I dropped, I failed maths, I think I got level 2 or so. [TN11-HS] (E/A)</p> <p>15. <u>[Then in this term, I am working at my best, I am trying all I can, by all means to pass mathematics but then I quite understand the work I did in term 1, 2, 3 now.*]</u> [TN7-HS, TN10a] (E)</p> <p>19. But then I told myself that nothing that I will never fail to overcome something that cannot talk], so I will try my best in Grade 11, I will keep on doing pure maths. [TN16] (E/I)</p> <p>20. I will try my best so that I can focus on my schoolwork so that I keep improving. [TN7-HS, TN16] (I)</p> <p>21. I also learnt that if you want to get into Rhodes University you need like a higher level so that you can get into these institutions and my career requires a higher level of mathematics and physical sciences. [TN16] (A/I)</p> <p>22. So I will work hard and do my best so that I can improve on my levels so that I can enter these institutions that I want to enter in life so that I can be a successful Marine</p> | <p>understand the work I did in term 1, 2, 3 now. [TN7-HS] (E)</p> <p>16. Then I am learning the new chapters that are in term 4, what I will do, I will adjust and take everything I did from term 1 to term 4 then work on it so that I can see the results. [TN7-HS, TN10a] (E)</p> <p>17. I also got previous papers for mathematics for November last year, so that I can work on the equations and see if I understand it and I also go to extra classes at school and also have a mathematics app on my phone that helps me to improve my results. [TN5, TN7-HS, TN10a] (E/A)</p> |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



|  |                                                        |  |
|--|--------------------------------------------------------|--|
|  | Biologist or a Medical Doctor.<br>[TN16, TN7-HS] (E/I) |  |
|--|--------------------------------------------------------|--|

[\*] denotes a phrase extracted to be coded additionally elsewhere

### 5.2.8.1 Ayabonga's narrative and Solomon's strands

#### *Ayabonga's narrative about nature of mathematics*

Ayabonga writes that he was a learner who found mathematics fun and challenging and describes it as a friend. He expounds that: "I saw that maths is actually a fun subject to do and I was loving it (Ayabonga. Written, 11) and also, "in my life maths has been a fun and a challenging subject and also it is my friend" (Ayabonga. Written, 14).

In his spoken narrative, he restates that when he started school, "maths was quite fun and it was easy" (Ayabonga. Spoken, 1) and he "didn't see any difficulty in maths, Grade 4, Grade 5, it was like fun" (Ayabonga. Spoken, 5).

However, he explains that he was a learner who experienced a shift in mathematics in grades 6 and 7 when they were introduced to algebra where "we got to solve x and stuff, so it was quite difficult for me because I was learning new things" (Ayabonga. Spoken, 6). He says the trend continued until high school where he described mathematics as "quite challenging" (Ayabonga. Spoken, 13) and "quite difficult" (Ayabonga. Spoken, 14) for him.

Ayabonga points out that his high school teacher further exacerbated his assumption that mathematics is quite challenging and difficult when he reflected that, "this past few weeks I asked my teacher how will maths be in Grade 11 and he didn't even, like beat around the bush he told me straight that it will be hard" (Ayabonga. Spoken, 18).

#### *Ayabonga's narrative himself as a maths learner*

Ayabonga believed that he was selected by his Grade 3 teacher to join the after school mathematics club because of his mathematical aptitude. He relates that his "Grade 3 teacher saw the potential I had in Mathematics and I was selected to be part of the Maths Club in Primary School" (Ayabonga. Written, 4).

He describes himself as a learner who had "love for mathematics" (Ayabonga. Written, 9) in primary school and continued that: "I went to high school in Grade 8 doing the same kind of maths and I was still loving it" (Ayabonga. Written, 10).

As he progressed to higher grades, he explains how mathematics shifted and how he remained a steadfast lover of the subject when he writes that mathematics:

was like upgraded to another level because it seemed difficult but I kept going though I fail term 1, I tried my best to have a good come back and luckily learned other new ways to find an answer e.g. new formulas. It was then that I decided to carry on doing Mathematics in Grade 10 and for the rest of my life, because maths is the only subject that I mostly love. So, I conclude by saying that in my life maths has been a fun and a challenging subject and also it is my friend (Ayabonga. Written, 12-14).

Probably to further illuminate his love for mathematics he boldly created the hashtag “#LOVEMATHEMATICS” (Ayabonga. Written, 15) as a conclusion to his narrative.

Ayabonga reflected in his spoken narrative that mathematics in FP was fun and challenging, and his performance was excellent:

because I understood everything from Grade 1 until Grade 2, then I continued in Grade 3, then in Grade 3 it was quite challenging because we, they added like multiplication stuff and everything, then I was quite good at it that I was even picked up to join maths clubs since they saw that my results are excellent in maths (Ayabonga. Spoken, 3).

He was a learner who believed that his exceptional performance and affinity for the subject resulted in his selection to join the mathematics club where he explains that: “I moved on to Grade 4, in Grade 4 I excelled at maths at my primary school (Ayabonga. Spoken, 4). I didn’t see any difficulty in maths, Grade 4, Grade 5, it was like fun, I love maths, every time I get home I practise, now and again” (Ayabonga. Spoken, 5). Ayabonga further showed agency in mathematical practice as he points out that, “I trained myself so that I can learn more so that I can solve more problems” (Ayabonga. Spoken, 6).

As a learner who was confident in his mathematical ability, he explains that:

I chose mathematics, pure maths because I saw from my past results that I was good at maths and that I love maths, it’s like my passion. Then ah I am still doing mathematics, I love it, but in Grade 10 it’s quite challenging because term 1 I did very very well, excellent, like level 7s and everything (Ayabonga. Spoken, 12-13).

Ayabonga’s mathematics journey has not been without challenges. He pointed out that in Grade 10: “In term 2 I dropped because they added like other things and then in term 3 they implemented like new laws, it was quite difficult for me, doing the graphs and then so I dropped, I failed maths, I think I got level 2 or so” (Ayabonga. Spoken, 14). The drop in the results disappointed him, but he vowed to work hard in order to fulfil his dream in tertiary education:

I will try my best so that I can focus on my schoolwork so that I keep improving. I also learnt that if you want to get into Rhodes University you need like a higher level so that you can get into these institutions and my career requires a higher level of mathematics and physical sciences. So I will work hard and do my best so that I can improve on my levels so that I can enter these institutions that I want to enter in life so that I can be a successful Marine Biologist or a Medical Doctor (Ayabonga. Spoken, 20-22).

### *Ayabonga's narrative of his engagement in mathematics*

Ayabonga recalls a story when they did simple activities in FP mathematics which included counting apples.

His engagement in mathematics continued in the after school mathematics clubs as he expounds that: "I got there and I learned new things and the math in that time was like upgraded, it was not the same as the maths that I was doing in Grade 1 (Ayabonga. Written, 5). The maths club help me to polish my skills in Maths and I was thought (taught) new ways to count or find answers" (Ayabonga. Written, 6). He further points out that his successful alignment and engagement in mathematics endured to the end of primary school when he writes that: "I went throw (through) the entire Primary, then I got to Grade 7 where we were (taught) a new level of mathematics (Ayabonga. Written, 7). I tried it and I saw that nothing was difficult at all, it was fun and challenging but that day I saw that I have love for mathematics" (Ayabonga. Written, 9).

Ayabonga's engagement and affinity for mathematics continued in high school where he writes that:

"In Grade 9 maths was like upgraded to another level because it seemed difficult but I kept going though I fail term 1, I tried my best to have a good come back and luckily learned other new ways to find an answer e.g. new formulars [sic]. It was then that I decided to carry on doing Mathematics in Grade 10 and for the rest of my life, because maths is the only subject that I mostly love (Ayabonga. Written, 12-13).

Ayabonga also explained that despite his love for mathematics, there was a period when engagement in mathematics was difficult. He singled out algebra and writes that: "It was then that I thought that maths was going to be hard because we were solving not only number but letters like (x)" (Ayabonga. Written, 8).

Ayabonga's spoken reflections on the FP showed that he was engaged in mathematical activities in the classrooms. He expounds that, "maths was quite fun and it was easy for me because we were working with simple, simple, simple, how can I put this, simple equations" (Ayabonga. Spoken, 1). He describes himself as a learner whose affinity for mathematics made him practise mathematics at home: "I love maths, every time I get home I practise, now and again" (Ayabonga. Spoken, 5).

He was a learner whose interaction with mathematics was not limited to school and home only as he also worked with a private tutor who "gave me different equations from different schools

and previous papers of the exams and then like I trained myself to do those equations and I excelled” (Ayabonga. Spoken, 10).

Ayabonga’s spoken narrative reveals his love and enjoyment and participation in mathematical activities where he went “to extra classes at school and also have a mathematics app on my phone that helps me to improve my results” (Ayabonga. Spoken, 17) and this has helped him to be a confident and competent mathematics learner.

### ***5.2.8.2 Ayabonga’s narrative and modes of belonging***

#### *Engagement*

Emile M describes his engagement in the after school mathematics club where mathematics had shifted and involved new concepts when he writes that:

It was then that in Grade 3 teachers saw the potential I have in Mathematics and I was selected to be part of the Maths Club in Primary School. I got there and I learned new things and the math in that time was like upgraded, it was not the same as the maths that I was doing in Grade 1 (Ayabonga. Written, 4-5).

He relates that the introduction of algebra (a new level of mathematics) in Grade 7 presented different challenges for him: “It was then that I thought that maths was going to be hard because we were solving not only number but letters like (x)” (Ayabonga. Written, 8), but when “I tried it...I saw that nothing was difficult at all, it was fun and challenging but that day I saw that I have love for mathematics” (Ayabonga. Written, 9) and he then committed to doing mathematics “for the rest of my life” (Ayabonga. Written, 13). He proceeds to say that: “I told myself that nothing, that, I will never fail to overcome something that cannot talk, so I will try my best in grade 11, I will keep on doing pure maths” (Ayabonga. Written, 19).

Ayabonga tells a story of the usual challenges of engagement on transition to high school when he recounts that, “then in high school, it hit me hard in grade 8 at first, because it was my first time doing like other equations, simplifying and factorising (Ayabonga. Written, 7). It hit me hard, but then I tried my best, and then, grade 9, that was the year, first term, I failed maths, I was quite disappointed” (Ayabonga. Written, 8).

Probably in line with his commitment to do mathematics ‘for the rest of his life’ he sought external ‘coaching’ services where he received “different equations from different schools and previous papers of the exams and then like I trained myself to do those equations and I excelled” (Ayabonga. Written, 10).

### *Alignment*

Just as alignment involves establishing common ground and defining broad visions through which learners communicate and through which they also belong to a practice (Goodnough, 2010), the SANCP after school mathematics club helped Ayabonga to “polish my skills in Maths and I was (taught) new ways to count or find answers” (Ayabonga. Written, 6).

He recounts that his engagement came across obstacles in the IP when he was introduced to algebra, “that was the year we got to solve  $x$  and stuff, so it was quite difficult for me because I was learning new things, so I didn’t like quite adjust” (Ayabonga. Spoken, 6). To curb the disalignment, Ayabonga explains that he engaged a private tutor who assisted him with his mathematical challenges. The tutor further “gave me different equations from different schools and previous papers of the exams” to continue practising at home and “I trained myself to do those equations and I excelled” (Ayabonga. Spoken, 10).

### *Imagination*

Ayabonga reflects in his mathematics engagement that, “every time I get home I practise, now and again” (Ayabonga. Spoken, 5) and for him, mathematics has now become “actually, a fun subject to do and I was loving it” (Ayabonga. Written, 11). He explains that his love for mathematics continued in high school although he imagined mathematics was “upgraded to another level because it seemed difficult, but I kept going though I fail term 1, I tried my best to have a good come back and luckily ) learned other new ways to find an answer e.g. new formulars’ [sic]” (Ayabonga. Written, 12). Ayabonga imagines that successful alignment with mathematics made him decide:

“to carry on doing Mathematics in Grade 10 and for the rest of my life, because maths is the only subject that I mostly love (Ayabonga. Written, 13). So, I conclude by saying that in my life maths has been a fun and a challenging subject and also it is my friend (Ayabonga. Written, 14). #LOVEMATHEMATICS” (Ayabonga. Written, 15).

The creation of the hashtag is probably indicative of the affinity, successful alignment and engagement in the subject and the amount of commitment he has for it.

Looking into the future, Ayabonga imagined himself in the medical profession. He chronicles that he: “to carry on doing Mathematics in Grade 10 and for the rest of my life, because maths is the only subject that I mostly love (Ayabonga. Written, 13). So, I conclude by saying that in my life maths has been a fun and a challenging subject and also it is my friend (Ayabonga. Written, 14). #LOVEMATHEMATICS” (Ayabonga. Written, 15).

The creation of the hashtag is probably indicative of the affinity, successful alignment and engagement in the subject and the amount of commitment he has for it.

Looking into the future, Ayabonga imagined himself in the medical profession. He chronicles that he:

learnt that, if you want to get into Rhodes University you need like a higher level so that you can get into these institutions and my career requires a higher level of mathematics and physical sciences. So I will work hard and do my best so that I can improve on my levels so that I can enter these institutions that I want to enter in life so that I can be a successful Marine Biologist or a Medical Doctor (Ayabonga. Written, 21-22).

His present engagement and alignment are clearly influenced by his future career aspirations.

Ayabonga's mathematics trajectory was not flawless as he describes his disappointment at failing in high school that, "it hit me hard, but then I tried my best, and then, Grade 9, that was the year, first term, I failed maths, I was quite disappointed" (Ayabonga. Spoken, 8), but he resolved to persevere and "I chose mathematics, pure maths because I saw from my past results that I was good at maths and that I love maths, it's like my passion" (Ayabonga. Spoken, 12).

Furthermore, he expounds that: "I told myself that nothing, that, I will never fail to overcome something that cannot talk, so I will try my best in Grade 11, I will keep on doing pure maths. (Ayabonga. Spoken, 19). I will try my best so that I can focus on my schoolwork so that I keep improving" (Ayabonga. Spoken, 20).

### **5.2.8.3 Summarising Ayabonga's identity stories**

Ayabonga positions himself as a learner who loves and enjoys mathematics and did not encounter difficulties in the FP but later there was a shift in mathematics and it was quite difficult in the IP when they were introduced to Algebra. His narrative about himself is as a learner who aligns with, enjoys and engages in mathematics regardless of it being quite *challenging* and *difficult* in high school.

He positions himself as a learner who loves mathematics, hence he created the hashtag: #LOVEMATHEMATICS (emphasis original). He also stories himself as a learner who participates in mathematical activities outside the school and has a private tutor and a mathematics application on his cellular phone.

Ayabonga stories himself as a focused hardworking learner who imagines himself doing mathematics for the rest of his life as a successful Marine Biologist or a Medical Doctor.

### 5.2.9 Nkosi: Narrative

Nkosi speaks about how his primary school teacher (3 utterances, TN1) and the club coordinator (1 utterance, TN2) helped him during his mathematics journey. He acknowledges the external assistance (6 utterances, TN5) that he received from various people outside the school and treasures the assistance from the after school mathematics club (7 utterances, TN6). He further chronicles how he enjoyed mathematics practice in the FP (6 utterances, TN7-FP), IP (2 utterances, TN7-IP) and in high school (6 utterances, TN7-HS) where he continues to do mathematics post the compulsory schooling stage in Grade 10. But he does not mention the assistance received from his teachers in high school (TN3) or any parental involvement in his learning (TN4).

Although Nkosi narrates moments when he struggled with mathematics engagement in the FP (1 utterance, TN11-FP), IP (4 utterances, TN11-IP) and in high school (8 utterances, TN11-HS), he still imagines continuing with subject in future (2 utterances, TN16) as he aspires to be a medical doctor, a course that requires advanced knowledge of mathematics (1 utterance, TN11).

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Nkosi's written and spoken stories.

Table 5.10 Nkosi's narrative

| Written Story                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Narratives about the nature of mathematics                                                                                                                                                      | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                                                | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p>10. In grade 7 and 8 maths started being more difficult and everyone was scared of maths. [TN11-IP, TN11-HS] (E/I)</p> <p>11. maths starting from grade 9 started being super difficult.</p> | <p>1. In Grade 1 when I started doing Maths, I hated it because I was always told that maths is hard, so I had that mind set. [TN11-FP] (E/I)</p> <p>2. My maths teacher helped me to change that mindset. [TN1] (E)</p> <p>3. She showed just because people think maths is hard does not mean it should be hard to me too. [TN1] (I)</p> | <p>6. In grade 3 I then joined Maths club. [TN6a] (E)</p> <p>7. I started practising maths every day because I wanted to solve (the club leader's) maths problem. [TN6a] (E)</p> <p>8. When maths club ended my sister helped me to practise maths and she was doing grade 12 then, but I wanted to know more and learn Maths skills every day. [TN5, TN7-IP] (E/A)</p> <p>9. In grade 7 and 8 maths started being more difficult and everyone was scared of maths and people kept on wishing that</p> |

|                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| <p>[TN11-HS]<br/>(I/A/E)</p>                                                                          | <p>4. As I grew up, I started to develop love for maths. [TN10a, TN7-FP] (I)</p> <p>5. I enjoyed maths because it challenged and pushed me to the limit. [TN7-FP] (E/I)</p> <p>7. My love for maths grew and [I started practising maths every day because I wanted to solve (the club leader's) maths problem*] and that has always motivated me to be the best maths student I can be. [TN6a, TN7-FP] (E/I)</p> <p>11. my love and passion for maths never ended so I chose to do Math in grade 10. [TN7-HS, TN10] (I)</p> | <p>they could change maths, but I saw this as a chance to test myself so [I practiced maths harder than ever until I got to a point where I was so good in Maths that my previous school sent me around the town and province doing maths competitions.*] [TN11-IP, TN11-HS, TN7-HS] (A/E/I)</p> <p>9. I practiced maths harder than ever until I got to a point where I was so good in Maths that my previous school sent me around the town and province doing maths competitions. [TN7-HS] (E/A)</p> <p>10. In high school everything changed. (I)</p> <p>11. I met people who also love maths and that I loved because [we helped each other*] because [maths starting from grade 9 started being super difficult*] and [we stayed together and worked as a team and we were able to pass Math*] and [my love and passion for maths never ended so I chose to do Math in grade 10.*] [TN5, TN11-HS, TN7-HS] (I/E/A)</p> <p>11. we helped each other. [TN5] (E)</p> <p>11. we stayed together and worked as a team and we were able to pass Math. [TN5] (E/A)</p> <p>12. So, my story still continues. [TN16] (I)</p> |
| Spoken Story                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <p><b>Narratives about the nature of mathematics</b></p>                                              | <p><b>Narratives about oneself as a maths learner</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p><b>Narratives of engagement in mathematics</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p>1. Okay, from Grade 1 I loved maths because then maths was easier than it is now. [TN7-FP] (E)</p> | <p>1. Okay, from Grade 1 I loved maths because then [maths was easier than it is now], so I enjoyed maths and I loved my maths teacher and that helped me to love maths too. [TN1a, TN7-FP, TN10a] (E)</p>                                                                                                                                                                                                                                                                                                                   | <p>3. So now (the club coordinator) and my maths friends we started maths after school and that helped me and I got good marks in Grade 3, and I loved maths and what motivated me was the maths club. [TN5, TN2, TN6a] (E/I)</p> <p>4. So, it was what motivated me to study maths every day but during Grade 4 then</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |



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| <p>9. Grade 9, eish, that was the hardest year, maths, it was very hard. [TN11-HS, TN10] (E)</p> | <p>2. Then in Grade 2 and Grade 3 the same, especially in Grade 3, because during Grade 3, that was the year I started in the maths club. [TN7-FP, TN10a, TN6a] (E)</p> <p>6. And then I went to high school, Grade 9, things went from worse to even worse because I started dropping, I didn't love maths now, that impacted me very much and now I started to upgrade on my marks because I started coming here and so I started to develop a positive attitude again to maths so this enabled me to study maths every day because of this. [TN10a, TN7-HS TN11-HS] (A/E/I)</p> <p>10. I don't like maths, I didn't study maths, I felt like maths was boring because I didn't love it anymore, you know. [TN11-HS] (E/I)</p> <p>11. And then even my teacher tried to help me, but I didn't care about maths anymore, I just cared about the other subjects, and that affected me. [TN5, TN11-HS] (E)</p> | <p>we stopped going to maths club, so from Grade 4 onwards then I stopped loving maths and then I started experiencing low marks because of that because I stopped practicing maths. [TN7-IP, TN6, TN10b, TN11-IP] (E)</p> <p>5. I stopped loving maths, I stopped having a positive attitude towards maths. [TN10b, TN11-IP] (E)</p> <p>7. I only study maths because of this, because it is motivating me to improve on my marks. [TN6a, TN7-HS] (E)</p> <p>8. Grade 8 was in my primary, my first year of high school was in grade 9. (E)</p> <p>12. Pure maths. [TN10a] (E)</p> <p>13. In future I will have to do maths because I want to be a doctor and it is required, I have to do maths. [TN11, TN16] (I)</p> |
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[\*] denotes a phrase extracted to be coded additionally elsewhere

### 5.2.9.1 Nkosi's narrative and Solomon's strands

#### *Nkosi's narrative about the nature of mathematics*

In his written narrative story, Nkosi pointed out that: "In grade 7 and 8 maths started being more difficult and everyone was scared of maths" (Nkosi. Written, 10). The fear of mathematics continued as "maths starting from grade 9 started being super difficult" (Nkosi. Written, 11).

Nkosi described mathematics in the spoken narrative as easier in primary school and that he loved the subject.

However, his first year in high school “was the hardest year” because “maths...was very hard” for him (Nkosi. Spoken 9). The transition from primary to high school presented him with difficult times that made him develop an aversion for mathematics.

*Nkosi's narrative about himself as a maths learner*

Nkosi described himself as a learner who hated mathematics when he started school, “because I was always told that maths is hard, so I had that mind set” (Nkosi. Written, 1), but his “maths teacher helped me to change that mindset (Nkosi. Written, 2). She showed (me) just because people think maths is hard does not mean it should be hard to me too” (Nkosi. Written, 3).

He reports that when he changed the mind-set that mathematics was hard, he immediately started “to develop love for maths (Nkosi. Written, 4). I enjoyed maths because it challenged and pushed me to the limit” (Nkosi. Written, 5).

Nkosi further reflects that his “love for maths grew and I started practising maths every day because I wanted to solve (the club coordinator's) maths problem and that has always motivated me to be the best maths student I can be” (Nkosi. Written, 7), and this “love and passion for maths never ended so I chose to do Math in grade 10” (Nkosi. Written, 11).

Nkosi began his interactive interview by describing himself as a learner who loved mathematics in the past when he states that:

Okay, from grade 1 I loved maths because then maths was easier than it is now, so I enjoyed maths and I loved my maths teacher and that helped me to love maths too. Then in grade 2 and grade 3 the same, especially in grade 3, because during grade 3, that was the year I started in the maths club. (Siya. Written, 1-2).

He explains that in high school his alignment and successful engagement in mathematics practice declined. Nkosi specifically states that, “in Grade 9, things went from worse to even worse because I started dropping, I didn't love maths now, that impacted me very much” (Nkosi. Spoken 6). He emphasised his aversion for mathematics when he stated that, “I don't like maths, I didn't study maths, I felt like maths was boring because I didn't love it anymore, you know” (Nkosi. Spoken, 10). Furthermore, he recalls that he became a learner who disregarded personal assistance from his mathematics teacher when he points out that, “even my teacher tried to help me, but I didn't care about maths anymore, I just cared about the other subjects, and that affected me” (Nkosi. Spoken, 11).

Interestingly, he reports that the assistance he received from SANCP Fun Day activities transformed him from the learner who “didn't care about maths anymore” to a learner who now loved and valued mathematics. He explained that, “now I started to upgrade on my marks

because I started coming here and so I started to develop a positive attitude again to maths so this enabled me to study maths every day because of this” ( Nkosi. Spoken, 6).

#### *Nkosi's narrative of his engagement in mathematics*

Nkosi explains the correlation between his engagement in mathematics and his participation in the after school mathematics club when he writes that:

I started practising maths every day because I wanted to solve (the club coordinator's) maths problem. When maths club ended my sister helped me to practise maths and she was doing grade 12 then, but I wanted to know more and learn Maths skills every day (Nkosi. Written, 7-8).

He reports that, although “in grade 7 and 8 maths started being more difficult and everyone was scared of maths and people kept on wishing that they could change maths,” (Nkosi. Written, 9) he “saw this as a chance to test myself so I practiced maths harder than ever until I got to a point where I was so good in Maths that my previous school sent me around the town and province doing maths competitions” (Nkosi. Written, 9).

He continued that engagement in mathematics persisted in high school as:

I met people who also love maths and that I loved because we helped each other because maths starting from grade 9 started being super difficult and we stayed together and worked as a team and we were able to pass Math and my love and passion for maths never ended so I chose to do Math in grade 10 (Siya. Written, 11).

Nkosi's discussion in the spoken narrative reveals that he participated in mathematics in primary school during the period that he was a member of the after school mathematics club more than he did in high school. He explains that: “So now (the club coordinator's) and my maths friends we started maths after school and that helped me and I got good marks in Grade 3, and I loved maths and what motivated me was the maths club” (Nkosi. Spoken, 3). He describes himself as a learner whose engagement in mathematics was affected by the discontinuation of the after school mathematics club when he states that, “so from Grade 4 onwards ... I stopped loving maths and then I started experiencing low marks because of that because I stopped practicing maths” (Nkosi. Spoken, 4).

Nkosi reports that the SANCP fun mathematics days, which were part of the SANCP's follow up and continued support of club learners, helped him to revive his love for mathematics when he stated that: “I only study maths because of this, because it is motivating me to improve on my marks” (Nkosi. Spoken, 7). He also imagines that: “In future I will have to do maths because I want to be a doctor and it is required, I have to do maths” (Nkosi. Spoken, 13).

### ***5.2.9.2 Nkosi's narrative and modes of belonging***

#### *Engagement*

Nkosi chronicles how he came into FP already hating mathematics, so that, “when I started doing Maths, I hated it because I was always told that maths is hard, so I had that mind set” (Nkosi. Written, 1), but her “maths teacher helped me to change that mindset” (Nkosi. Written, 2) and as he progressed in his mathematics trajectory, he “enjoyed maths because it challenged and pushed me to the limit” (Nkosi. Written, 5).

After joining the SANCP after school mathematics club, he tells a story of a learner who “started practising maths every day because I wanted to solve (the club coordinator’s) maths problem” (Nkosi. Written, 7). He continues that he started getting “good marks in Grade three, and I loved maths and what motivated me was the maths club” (Nkosi. Spoken, 3).

He however reports that the SANCP after school mathematics club for his school only ran for one year and “so from Grade 4 onwards...I stopped loving maths and then I started experiencing low marks because of that, because I stopped practicing maths” (Nkosi. Spoken, 4). The motivation to engage in mathematics practice died and he relates that: “I stopped loving maths, I stopped having a positive attitude towards maths” (Nkosi. Spoken 5).

Interestingly, Nkosi’s engagement in mathematics practice was resuscitated by his sister who, when the mathematics club discontinued, helped him “to practise maths and she was doing grade 12 then, but I wanted to know more and learn Maths skills every day” (Nkosi. Written, 8). I practiced maths harder than ever until I got to a point where I was so good in Maths that my previous school sent me around the town and province doing maths competitions” (Nkosi. Written, 9).

Nkosi narrates a difficult transition to high school, where Grade 9 “was the hardest year, maths, it was very hard” (Nkosi. Spoken 9), where his performance “went from worse to even worse because I started dropping, I didn’t love maths now, that impacted me very much,” but as what happened after the discontinuation of the after school mathematics club in primary, he started to work hard again and developed “a positive attitude again to maths so this enabled me to study maths every day” (Nkosi. Spoken, 6).

Nkosi reports that he was lucky when he “met people who also love maths and that I loved because we helped each other because maths starting from grade 9 started being super difficult

and we stayed together and worked as a team and we were able to pass Math and my love and passion for maths never ended so I chose to do Math in grade 10” (Nkosi. Written, 11).

### *Alignment*

Nkosi reports that he was the learner who learned strategies to align in mathematics practice in the SANCP after school mathematics club. When the SANCP after school club in his school was discontinued, Nkosi’s need to align with mathematics practice was supported by her sister who helped him to practise maths. He expounds that he “practiced maths harder than ever until I got to a point where I was so good in Maths that my previous school sent me around the town and province doing maths competitions” (Nkosi. Written, 9).

### *Imagination*

Nkosi begins his written story by reflecting that, “when I started doing Maths, I hated it because I was always told that maths is hard, so I had that mind set” (Nkosi. Written, 1) but the hatred did not last long because “maths was easier than it is now, so I enjoyed maths and I loved my maths teacher and that helped me to love maths too” (Nkosi. Spoken, 1) in primary school. He adds that: “I enjoyed maths because it challenged and pushed me to the limit” (Nkosi. Written, 5).

His transition to high school brought about temporary mathematical obstacles that threatened to undo all the affinity for mathematics that he had built in primary school. Nkosi reflects that: “Grade 9, eish, that was the hardest year, maths, it was very hard (Nkosi. Spoken, 9). I don’t like maths, I didn’t study maths, I felt like maths was boring because I didn’t love it anymore, you know” (Nkosi. Spoken, 10).

But, later in high school, he narrates that: “I started to develop a positive attitude again to maths so this enabled me to study maths every day because of this” (Nkosi. Spoken, 6). He continues that, from that time his “love and passion for maths never ended so I chose to do Math in grade 10” (Nkosi. Written, 11).

### **5.2.8.3 Summarising Siya’s identity stories**

Nkosi’s narrative about himself is as a learner who hated mathematics because he was always told that mathematics was hard, but as time went by, he loved and practiced mathematics harder than before until he got to a point where he became so good that his previous school sent him around the town and province doing mathematics competitions.

He stories himself as a learner who enjoys mathematics because it challenges and pushes him to the limit where he develops a positive attitude towards mathematics which enables him to study it every day. He further positions himself as a learner who identifies himself as a learner whose love for mathematics developed in the SANCP after school mathematics club.

Nkosi's narrative about himself is as a learner who disengaged from mathematics participation and did not align with it in Grade 9 as he perceived it as boring.

He positions himself as a learner who has developed love and passion for mathematics and has chosen to do Mathematics post the compulsory schooling stage. He imagines doing mathematics post high school because he wants to be a doctor.

### 5.2.10 Esihle: Narrative

Most of Esihle's narratives relate to her enjoyment of mathematics practice in FP (6 utterances, TN7-FP) and high school (14 utterances, TN7-HS) which probably links to her participation in after school mathematics club (9 utterances, TN6) and her ability to seek external assistance (1, TN5) when faced with difficult mathematics concepts.

The bulk of her narratives however chronicle her difficult episodes in mathematics practice in the IP (4 utterances, TN11-IP) and high school (7 utterances, TN11-HS), but she explains that she endured because she realised that her performance is getting solid all the time and she intends to continue doing mathematics in future (1 utterance, TN16).

Esihle does not speak about the following narratives at all, (TN1), (TN2), (TN3), (TN4) and (TN7-IP).

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Esihle's written and spoken stories.

Table 5.11 Esihle's narrative

| Written Story                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| Narratives about the nature of mathematics                                                                                                                                                                                                                                                                                                                                 | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <p>2. maths was fun and extremely easy. [TN7-FP] (E)</p> <p>9. In grade 7 maths became more harder and there was a lot of work done there came solving x variables geometry and so on. [TN11-IP] (E/A)</p> <p>10. maths is fun. [TN7-HS] (E)</p> <p>11. Grade 8 maths is light and was hard at the same time that maths confused me sometimes... [TN7-HS, TN11-HS] (A)</p> | <p>7. I loved the maths club because we had maths tricks that we used while doing an activity. [TN6a] (E)</p> <p>10. The maths is fun but you need to focus that's the rule I told myself while was going to high school and if you practise maths then you will achieve. [TN7-HS] (E)</p> <p>12. There was no one no extra class like the maths club felt alone without the maths club in the new school. (E) [TN6a]</p> <p>15. I wish we have the same club even here in high school and carry on</p> | <p>1. I started primary in 2011 that year I was doing grade 1. (E)</p> <p>2. At that time [<u>maths was fun and extremely easy*</u>] because we were just adding small numbers and subtracting. [TN7-FP] (E)</p> <p>3. At that stage we used anything to calculate we used bottle tops and fingers etc. [TN10a] (E)</p> <p>4. At grade 3 we used to do mental maths where the teacher gives us a statement and we calculate without writing down. [TN10a] (E)</p> <p>5. In 2014 I was doing grade 4 there was a lot of work done comparing to foundation phase. [TN10a] (E)</p> <p>6. It's when I started maths club, in the maths club, in the maths club we had an opportunity to count using cards and</p> |

|                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| <p>13. In grade 9 my maths was fun it is challenging. [TN7-HS, TN11-HS] (I)</p> <p>14*. It is very exciting... [TN7-HS] (E)</p>                                                                                        | <p>with the helping club. [TN6a] (I)</p>                                                                                                                                                                                                                                                                                                                                                                                     | <p>we used very exciting maths activities. [TN6a] (E)</p> <p><u>7. [I loved the maths club because we had maths tricks that we used while doing an activity*]. [TN6a] (E)</u></p> <p>8. During the clubs there was a time where we had a test before the term ends we solved some issues and math problems. [TN6a] (E)</p> <p>10. <u>[The [maths is fun*] but you need to focus that's the rule I told myself while was going to high school and if you practise maths then you will achieve*]. [TN7-HS] (E)</u></p> <p>11. <u>[Grade 8 maths is light and was hard at the same time that maths confused me sometimes*]</u> and as the time goes, I achieved a lot and the only term that I struggled was term 1 where I had level 3 but term 2 I upgraded. [TN7-HS, TN11-HS] (E)</p> <p>14. <u>[It is very exciting*]</u> because I compete with my friends and help each other with our maths problems. [TN7-HS, TN5] (I)</p> |
| <b>Spoken Story: Interview</b>                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Narratives about the nature of mathematics</b>                                                                                                                                                                      | <b>Narratives about oneself as a maths learner</b>                                                                                                                                                                                                                                                                                                                                                                           | <b>Narratives of engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <p>1. Okay, from Grade 1 maths was fun... [TN7-FP] (E)</p> <p>2. It was very easy then as the time goes, as the grade are growing up it started being difficult but not that difficult, easy to do... [TN7-FP] (E)</p> | <p><u>7. [The maths club ended in Grade 7*.]</u> then in Grade 8 I felt like there was no one to help me, I had no ideas and <u>[it was very challenging.*]</u> [TN11-HS] (E/I)</p> <p>8. Firstly in the first term I wasn't doing well because, I don't know whether I was scared of high school or I felt lonely, I'm not sure, but in the first term I didn't do well but <u>[as the time goes I understood maths</u></p> | <p>1. <u>[Okay, from Grade 1 maths was fun*]</u> because we were just doing easy things like counting with bottle lids. [TN10a, TN7-FP] (E)</p> <p>2. <u>[It was very easy then as the time goes, as the grade are growing up it started being difficult but not that difficult, easy to do*]</u> and in Grade 4 we started counting seriously because we were no longer using bottle lids or fingers to count so we were counting...I could say we started doing the real maths. [TN7-FP, TN11-IP] (E/A)</p>                                                                                                                                                                                                                                                                                                                                                                                                                   |



|                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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| <p>6. ...it was challenging yeah. [TN11-HS] (E)</p> <p>7. ...it was very challenging. [TN11-HS] (E)</p> <p>9. I'll be doing maths because it is very fun. [TN7-HS] (E/I)</p> | <p>because now I'm in Grade 9 and I'm doing well, very very well.*] [TN11-HS, TN7-HS] (E/I)</p> <p>8. ...as the time goes I understood maths because now I'm in Grade 9 and I'm doing well, very very well. [TN7-HS] (E)</p> <p>9. [I'll be doing maths because it is very fun*] and I understand how to solve the x's because it is mainly solving the x's, so I'll be doing that. [TN7-HS] (A/I/E)</p> <p>10. I think in the next years I'll be doing good because from Grade 8 I can see difference now because [I'm having good marks in my maths, so I think as the years go I'll be having much good marks than the ones that I have now.*] [TN16, TN7-HS] (E/I)</p> <p>10. I'm having good marks in my maths, so I think as the years go, I'll be having much good marks than the ones that I have now. [TN7-HS] (E/I)</p> | <p>3. I then joined the maths in Grade 4 and then we okay, in the maths club we were taught easy ways to do maths. [TN6a] (E/A)</p> <p>4. We were given easy solutions like using cards by counting and in Grade 7 we started solving x's. [TN6a] (E/A)</p> <p>5. That's when it started seriously. (E) [TN11-IP]</p> <p>6. We started solving serious, it wasn't fun, but [it was challenging yeah.*] [TN11-IP] (E)</p> <p>7. The maths club ended in Grade 7... [TN6b] (E)</p> |
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[\*] denotes a phrase extracted to be coded additionally elsewhere

#### 5.2.10.1 Esihle's narrative and Solomon's strands

##### *Esihle's narrative about the nature of mathematics*

Esihle writes that mathematics was largely “fun and extremely easy” (Esihle. Written, 2) in some sections in both primary and high school. She singled out Grade 7 as the period that “maths became more harder and there was a lot of work done, there came solving x variables, geometry and so on” (Esihle. Written, 9).

She explains that she was the learner who viewed mathematics as light and hard at the same time, she continues to explain that “maths confused me sometimes” (Esihle. Written, 11).

Although she described mathematics as “very exciting” (Esihle. Written, 14) in some sections in grade 8, she reveals that “in grade 9 my maths was ... challenging” (Esihle. Written, 13).

In the spoken narrative, Esihle describes mathematics as fun in the past and she continued “doing maths because it is very fun...” (Esihle. Spoken, 9). She however acknowledges that although mathematics “was very easy then, as the time goes, as the grades are growing up it started being difficult but not that difficult” (Esihle. Spoken, 2). In other words, she embraced the difficult episodes that she came across in her mathematical journey. This probably explained her choice to continue doing mathematics post compulsory schooling stage.

#### *Esihle’s narrative about herself as a maths learner*

In the written narrative Esihle explains that she was a learner who loved the maths club because in the club they were taught “maths tricks that we used while doing an activity” (Esihle. Written, 7).

She also tells a story that she believed that “maths is fun but you need to focus” and “that’s the rule I told myself while I was going to high school (that) if you practise maths then you will achieve” (Esihle. Written, 10).

Furthermore, Esihle describes the importance of after school mathematics clubs and called for their continuation post primary school when she writes that: “I wish we have the same club even here in high school and carry on with the helping club” (Esihle. Written, 15). She lamented that: “There was no one, no extra class like the maths club felt alone without the maths club in the new school” (Esihle. Written, 12).

Although Esihle alluded to coming across difficulties in her mathematics practice, she imagines:, “I think in the next years I’ll be doing good because from Grade 8 I can see difference now because I’m having good marks in my maths, so I think as the years go I’ll be having much good marks than the ones that I have now” (Esihle. Spoken, 10). In other words, she saw potential in herself as a mathematics learner.

In the same spoken narrative, she further describes herself as a competent learner in the subject when she states that “...as the time goes, I understood maths because now I’m in Grade 9 and I’m doing well, very, very well (Esihle. Spoken, 8). I’ll be doing maths because it is very fun and I understand how to solve the x’s because it is mainly solving the x’s, so I’ll be doing that”

(Esihle. Spoken, 9). Her belief that she is a competent mathematics learner probably made her choose to take up mathematics at Grade 10.

Esihle perceives herself as a learner who probably needs external assistance all the time in her mathematical work, she reveals that when “the maths club ended in Grade 7, ... in Grade 8 I felt like there was no one to help me, I had no ideas and it was very challenging” (Esihle. Spoken, 7). She continues to explain that “in the first term I wasn’t doing well because, I don’t know whether I was scared of high school or I felt lonely, I’m not sure, but in the first term I didn’t do well but as the time goes I understood maths because now I’m in Grade 9 and I’m doing well, very very well” (Esihle. Spoken, 8).

### *Esihle’s narrative of her engagement in mathematics*

Esihle describes her engagement in mathematics as enjoyable in the past because:

At that time maths was fun and extremely easy because we were just adding small numbers and subtracting (Esihle. Written, 2). At that stage we used anything to calculate we used bottle tops and fingers etc. (Esihle. Written, 3). At grade 3 we used to do mental maths where the teacher gives us a statement and we calculate without writing down (Esihle. Written, 4).

She continued to enjoy her engagement in mathematics although in “grade 4 there was a lot of work done comparing to foundation phase” (Esihle. Written, 5). It was then that she “started maths club, in the maths club we had an opportunity to count using cards and we used very exciting maths activities” (Esihle. Written, 6). Esihle reflects that she was a learner who “loved the maths club because we had maths tricks that we used while doing an activity (Esihle. Written, 7). During the clubs there was a time where we had a test before the term ends, we solved some issues and math problems” (Esihle. Written, 8).

In her engagement in mathematics, Esihle pointed out that although the subject was *fun*, she taught herself “to focus, that’s the rule I told myself while I was going to high school and if you practise maths then you will achieve” (Esihle. Written, 10). She continued practising mathematics and found grade 8 mathematics was *light and hard at the same time*. She reveals that in grade 8, “maths confused me sometimes and as the time goes, I achieved a lot and the only term that I struggled was term 1 where I had level 3 but term 2 I upgraded” (Esihle. Written, 11).

She concludes her narrative by highlighting her continued engagement in mathematics, that in “grade 9 my maths was fun it is challenging (Esihle. Written, 13). It is very exciting because I compete with my friends and help each other with our maths problems” (Esihle. Written, 14).

In her spoken narrative, Esihle tells of stories when she was actively engaged in mathematical activities and some episodes that she was less engaged. She explains active engagement in the past:

Okay, from Grade 1 maths was fun because we were just doing easy things like counting with bottle lids. It was very easy then, as the time goes, as the grades are growing up it started being difficult but not that difficult, easy to do and in Grade 4 we started counting seriously because we were no longer using bottle lids or fingers to count so we were counting...I could say we started doing the real maths (Esihle. Spoken, 1-2).

She further discusses how she was actively engaged in the after school mathematics clubs that: “I then joined the maths club in Grade 4 and then we okay, in the maths club we were taught easy ways to do maths” (Esihle. Spoken, 3).

Along her mathematics journey in primary, she explains that she started encountering difficulties in her engagement in mathematics practice. She reveals that although they sometimes used cards to solve mathematical problems, “in Grade 7 we started solving xs (Esihle. Spoken, 4). We started solving serious, it wasn’t fun, but it was challenging yeah (Esihle. Spoken, 6). The maths club ended in Grade 7...” (Esihle. Spoken, 7). The difficult moments were probably compounded by the end of the after school mathematics clubs which usually helped her in coming up with solutions to mathematical challenges.

#### ***5.2.10.2 Esihle’s narrative and modes of belonging***

##### *Engagement*

Esihle explains that in the past mathematics “was fun and extremely easy because we were just adding small numbers and subtracting” (Esihle. Written, 2). At that stage learners usually use manipulatives to do their calculations, but “as the time goes, as the grade(s) are growing up it started being difficult but not that difficult, easy to do and in Grade 4 we started counting seriously because we were no longer using bottle lids or fingers to count, so we were counting...I could say we started doing the real maths” (Esihle. Spoken, 2).

Esihle joined the SANCP after school maths club in Grade 4 and reveals that, “in the maths club we were taught easy ways to do maths” (Esihle. Spoken, 3) and “we had an opportunity to count using cards and we used very exciting maths activities” (Esihle. Written, 6). She continues that, “I loved the maths club because we had maths tricks that we used while doing an activity (Esihle. Written, 7). During the clubs there was a time where we had a test before the term ends, we solved some issues and math problems” (Esihle. Written, 8). She expresses

a wish that the clubs could be introduced in high school as they really assisted her mathematics alignment and engagement in primary school.

Esihle describes mathematics engagement became difficult for her in Grade 7 where it “became more harder and there was a lot of work done, there came solving  $x$  variables, geometry and so on” (Esihle. Written, 9). She continues that they “started solving serious, it wasn’t fun, but it was challenging yeah” (Esihle. Spoken, 6).

Although mathematics was made fun and exciting in the clubs, Esihle reports that in high school learners needed, “to focus, that’s the rule I told myself while I was going to high school and if you practise maths then you will achieve” (Esihle. Written, 10). She tells a story that in Grade 8, she encountered some challenges since “in the first term I wasn’t doing well because, I don’t know whether I was scared of high school or I felt lonely, I’m not sure, but in the first term I didn’t do well but as the time goes I understood maths because now I’m in Grade 9 and I’m doing well, very very well” (Esihle. Spoken, 8).

### *Alignment*

Esihle’s alignment with mathematical activities is more pronounced in the SANCP after school mathematics club where she expounds that, “in the maths club we were taught easy ways to do maths” (Esihle. Spoken, 3) although in Grade 7, “maths became more harder and there was a lot of work done, there came solving  $x$  variables geometry and so on” (Esihle. Written, 9).

Esihle’s narratives aligns more towards positive engagement with mathematics despite the few episodes of disalignment where she expounds that: “Grade 8 maths is light and was hard at the same time, that maths confused me sometimes...” (Esihle. Spoken, 11), but she chose to continue doing mathematics “because it is very fun and I understand how to solve the  $x$ ’s because it is mainly solving the  $x$ ’s, so I’ll be doing that” (Esihle. Written, 9).

### *Imagination*

Esihle imagines the assistance that she used to receive in the SANCP after school mathematics club and wishes the club could be continued in high school because, “there was no one, no extra class like the maths club, felt alone without the maths club in the new school” (Esihle. Written, 12). She further imagines that mathematics is both fun and challenging, but she enjoys it as “it is very exciting because I compete with my friends and help each other with our maths problems (Esihle. Written, 14). I wish we have the same club even here in high school and carry on with the helping club” (Esihle. Written, 15).

### ***5.2.10.3 Summarising Esihle's identity stories***

Esihle identifies mathematics as fun and extremely easy in the FP but challenging in the IP. She reveals that she loves the after school mathematics club because they were taught easy ways of doing mathematics.

Esihle's narrative about herself is as a learner who was initially scared and felt lonely in the new landscape of practice in high school. While she says she was once scared and felt lonely, she stories herself as a learner who later on discovered that mathematics was fun, and she started doing very well and even decided to choose Mathematics post the compulsory schooling stage.

Esihle identifies mathematics as fun and exciting on one hand and hard, challenging and confusing on the other.

### 5.2.11 Khethiwe: Narrative

The bulk of thematic narratives that Khethiwe tells illuminate her engagement with mathematics outside her classroom (8 utterances, T N5), in the after school mathematics club (11 utterances, TN6) and at home, with the assistance of her parents (4 utterances, TN4). She explains that she enjoyed participation in mathematics activities in the FP (2 utterances, TN7-FP) and high school (2 utterances, TN7-HS) but did not say anything about the IP (TN7-IP).

Khethiwe recounts the assistance that she received from more knowledgeable people around her such as the primary school teacher (2 utterances, TN1), after school mathematics club coordinator (1 utterance, TN1) and her high school mathematics teachers (1 utterance, TN1).

She also recounts instances where she faced challenges in mathematics participation both in the FP (3 utterances, TN11-FP), IP (1 utterance, TN11-IP) and high school (2 utterances, TN11-HS). Khethiwe's narrative shows that she is aware of the gatekeeper effect of mathematics (1, TN9) and imagines a future of lifelong mathematics learning (1 utterance, TN16) as a pilot or any other career that requires mathematics

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Khethiwe's written and spoken stories.

Table 5.12 Khethiwe's narrative

| Written Story                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Narratives about the nature of mathematics                                                   | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                                                                                                                                                                        | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                            |
| 1. MATHS IS FUN!!! [TN7-HS] (I)<br><br>23. Mathematics was helpful to me a lot!! [TN10a] (I) | 1. In grade 1 2011 I was struggling to do maths because I was 9 years old. [TN11-FP] (E)<br><br>2. I didn't understand how to count the maths. [TN11-FP] (E)<br><br>5. I couldn't understand the difference between the signs of multiplication, subtraction and adding. [TN10b] (A)<br><br>11. In grade 7, I used to struggle because it was a little bit hard because it was my first time seeing x's and I couldn't understand how to solve them. [TN11-IP] (A) | 2. I was taught by Mrs [X] so [I didn't understand how to count the maths*]. [TN11-FP, TN1a] (E)<br><br>3. My help to count maths I used to use toothpicks as numbers. [TN10a] (E)<br><br>4. I subtract that stick without getting help from my mother or father. [TN5] (E)<br><br>6. In grade 3 we were not allowed to use calculators so I started Maths with (the club coordinator). [TN6a] (E) |

|                         |                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <p>13. Also I used to get lost to make the difference of 2D shape and 3D. [TN10b] (A)</p> <p>18. In grade 9 I struggled a lot, I won't lie (emoji laughing) because I couldn't hear the teacher when he was teaching. [TN11-HS] (I)</p> | <p>7. Every morning in class we used to make registration of maths. [TN10a] (E)</p> <p>8. I subtract that stick without getting help from my mother or father. [TN5] (E)</p> <p>9. We were attending Maths Club on Tuesdays at 14:30pm afternoon. [TN5] (E)</p> <p>10. In Mrs [X]'s class we used to go outside to play maths games. [TN1] (E)</p> <p>12. I talked to (the club coordinator) about the issue about how to solve x's, she helped me. [TN2] (E)</p> <p>14. Maths club of (the club coordinator) and also (the club coordinator) helped me, because in class I couldn't get enough explanation. [TN6a] (A)</p> <p>15. So I thought about Maths club. [TN6a] (A)</p> <p>16. In every term before it ends we were given some tests to write so they can see we were listening over the term. [TN6a] (E)</p> <p>17. Me and Emihle over the end of year we received maths box full of different shapes with elastics so you can add and gives you 2D shape. [TN6a] (E)</p> <p>19. Then I asked the maths teacher the other one, that can't she get us some people to help us with maths. [TN5] (E)</p> <p>20. Then she get some learners of [Vuyani High] to help us. [TN5] (E)</p> <p>21. It's been 2 months now since I was attending. (E).</p> |
| Spoken Story: Interview |                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |



| Narratives about the nature of mathematics | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                            | <p>1. I understood maths then... [TN7-FP] (E)</p> <p>1. I used to, to get help from my mother, then I started maths club in Grade 4, then that's when I learnt maths. [TN4] (E)</p> <p>2. In maths club I used to get help from a very lot of things for example, I didn't know how to multiply, I used to calculate when I had to multiply by the bottle lids. [TN6a] (E)</p> <p>4. When I arrived at Mtambo High School, I was getting new to maths of high school because some of them I had never come across them and then <u>[I got help from my father because he loves maths and he is able to do it*]</u>, so even <u>[our Principal offered that he would do afternoon classes of maths for Grade 8 so I attended it so that's how I got help in maths.*]</u> [TN11-HS, TN4, TN5] (E/A)</p> <p>4. I got help from my father because he loves maths and he is able to do it. [TN4] (E/A)</p> <p>7. I will be doing maths, pure maths next year because I love maths more than maths lit because that's the one I understand and love more than maths lit. [TN7-HS] (I)</p> <p>8. When I started school I didn't take it as a serious thing, I thought it was just for fun to go to school and come back home, so I started to be serious at the age of...I am not sure... but in Grade 3 when we had some tasks of maths then I saw myself that I wasn't great, so <u>[I started to get up for myself and be</u></p> | <p>1. So I was doing Grade 1, <u>[I understood maths then*]</u>, when I arrived home, when I had home works,<u>[ I used to, to get help from my mother, then I started maths club in grade 4, then that's when I learnt maths.*]</u> [TN7-FP, TN4, TN6a] (E)</p> <p>2. <u>[In maths club I used to get help from a very lot of things for example, I didn't know how to multiply, I used to calculate when I had to multiply by the bottle lids.*]</u> [TN6a] (E)</p> <p>3. Then in Grade 5 (the club coordinator) came with cards to play with us, we ended the maths clubs in Grade 7 at S. Msholozzi Primary. [TN6a] (E)</p> <p>4. our Principal offered that he would do afternoon classes of maths for Grade 8 so I attended it so that's how I got help in maths. [TN5] (E/A)</p> <p>5. Grade 9 was easy to me because my teacher, I understood Mr [Q]. [TN3a] (E)</p> <p>6. And then we even got help from [Vuyani High] girls that are coming to help us with maths every Tuesday. [TN5] (E)</p> <p>8*. I started to get up for myself and be serious in maths, so next year in Grade 4 that's when I joined maths club. [TN6a] (E)</p> |

|  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p><u>serious in maths, so next year in Grade 4 that's when I joined maths club.*]. [TN6a] (E)</u></p> <p>9. It will help me because I, because I because I don't know, because I am not sure what I am going to be when I grow up, because I wanted to be a pilot first but am struggling with Geography so I decided not to be a pilot anymore, so I am not sure about the career now. [TN11, TN16] (I)</p> |  |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

[\*] denotes a phrase extracted to be coded additionally elsewhere

### 5.2.11.1 Khethiwe's narrative and Solomon's strands

#### *Khethiwe's narrative about the nature of mathematics*

Khethiwe writes that she was a learner who struggled in mathematics because it was hard for her in Grade 7, but later in her written narrative she boldly claims that: "MATHS IS FUN!!!" (Emphasis original) (Khethiwe. Written, 22).

#### *Khethiwe's narrative about herself as a maths learner*

Khethiwe explains in the written story that in the past she "was struggling to do maths because I was 9 years old (Khethiwe. Written, 1). I didn't understand how to count the maths" (Khethiwe. Written, 2). She continues that: "I couldn't understand the difference between the signs of multiplication, subtraction and adding" (Khethiwe. Written, 5).

She describes herself as a learner who struggled in Grade 7 "because it was a little bit hard because it was my first time seeing xs and I couldn't understand how to solve them" (Khethiwe. Written, 11). Besides complications in algebra, she also "used to get lost to make the difference of 2D shape and 3D" (Khethiwe. Written, 13).

Khethiwe presents a picture of herself as a mathematics learner who faced difficulties most of the times in her mathematics journey from primary to high school. She reflects that: "In grade 9 I struggled a lot, I won't lie 😊😊 because I couldn't hear the teacher when he was teaching" (Khethiwe. Written, 18).

In her spoken narrative story, Khethiwe explains that she "understood maths" because of the support structures in her landscapes of practice whereby "when I arrived home, when I had home works, I used to, to get help from my mother, then I started maths club in Grade 4, then

that's when I learnt maths" (Khethiwe. Spoken, 1). The support structures in her life made her perceive herself as a competent mathematics learner who became conversant with various mathematical concepts when she states that, in the "maths club I used to get help from a very lot of things..." (Khethiwe. Spoken, 2).

She imagines that in future, in the post compulsory schooling stage she "will be doing maths, pure maths next year because I love maths" (Khethiwe. Spoken, 7). Her love is despite the fact that: "I wanted to be a pilot first but am struggling with Geography, so I decided not to be a pilot anymore, so I am not sure about the career now" (Khethiwe. Spoken, 9).

Khethiwe explains that she was a learner whose affinity for mathematics came later in school because:

When I started school, I didn't take it as a serious thing, I thought it was just for fun to go to school and come back home, so I started to be serious at the age of...I am not sure... but in Grade 3 when we had some tasks of maths then I saw myself that I wasn't great, so I started to get up for myself and be serious in maths, so next year in Grade 4 that's when I joined I maths club (Khethiwe. Spoken, 8).

#### *Khethiwe's narrative of her engagement in mathematics*

Khethiwe writes that in FP, her "help to count maths I used to use toothpicks as numbers (Khethiwe. Written, 3). I subtract that stick without getting help from my mother or father" (Khethiwe. Written, 4). The use of the sticks and toothpicks was necessary because in "grade 3 we were not allowed to use calculators" (Khethiwe. Written, 6).

Khethiwe joined the after school mathematics club in Grade 3. She expounds that the "Maths club of (club coordinator's name) helped me, because in class I couldn't get enough explanation" (Khethiwe. Written, 14), and when that happened, she would think back to how they dealt with the various problems in the after school mathematics clubs.

She tells of stories of enjoyment in mathematics engagement where: "Every morning in class we used to make registration of maths" (Khethiwe. Written, 7), and when her class "used to go outside to play maths games" (Khethiwe. Written, 10).

When faced with challenging moments in her practice, she writes that: "I talked to (club coordinator) about the issue about how to solve xs, she helped me" (Khethiwe. Written, 12).

She describes further mathematics engagement where: "In every term before it ends we were given some tests to write so they can see we were listening over the term (Khethiwe. Written, 16). Me and Esihle over the end of year we received maths box full of different shapes with elastics so you can add and gives you 2D shape" (Khethiwe. Written, 17).

In high school, Khethiwe explained that she “asked the maths teacher the other one, that can’t she get us some people to help us with maths (Khethiwe. Written, 19). Then she get some learners of [Vuyani High] to help us (Khethiwe. Written, 20). It’s been 2 months now since I was attending” (Khethiwe. Written, 21).

Khethiwe’s engagement in mathematics shows reliance on external assistance. She explains in the spoken narrative that in the past:

I understood maths then, when I arrived home, when I had home works, I used to, to get help from my mother, then I started maths club in Grade 4, then that’s when I learnt maths. In maths club I used to get help from a very lot of things for example, I didn’t know how to multiply, I used to calculate when I had to multiply by the bottle lids (Khethiwe. Spoken, 1-2).

She further illuminates agency when she explains that in the IP: “I started to get up for myself and be serious in maths, so next year in Grade 4 that’s when I joined maths club” (Khethiwe. Spoken, 8) where she received significant assistance in solving various mathematical concepts.

She specifically singles out her after school mathematics club coordinator, her Grade 9 mathematics teacher, her high school principal, and a group of learners from one of their neighbouring schools as people who assisted her in her work:

Then in Grade 5 (the club coordinator) came with cards to play with us, we ended the maths clubs in Grade 7 at S. Msholozzi Primary ... our principal offered that he would do afternoon classes of maths for Grade 8 so I attended it so that’s how I got help in maths. Grade 9 was easy to me because my teacher, I understood Mr [Y]. And then we even got help from [Vuyani High learners] that are coming to help us with maths every Tuesday (Khethiwe. Spoken, 3-6).

Next, I present Khethiwe’s narrative mathematical identities that are narrated in both her written and spoken narrative stories.

### ***5.2.11.2 Khethiwe’s narrative and modes of belonging***

#### *Engagement*

Khethiwe narrates that she was a learner who “didn’t understand how to count the maths” (Khethiwe. Written, 2) and “couldn’t understand the difference between the signs of multiplication, subtraction and adding” (Khethiwe. Written, 5), so she “used to, to get help from my mother” (Khethiwe. Spoken, 1).

She joined the SANCP after school mathematics club in Grade 3 where she relates that she “used to get help from a very lot of things for example, I didn’t know how to multiply, I used to calculate when I had to multiply by the bottle lids” (Khethiwe. Spoken, 2). She also tells a story of when she faced challenges with algebra, and she approached a more knowledgeable

person to assist her: “I talked to (the club coordinator) about the issue about how to solve x’s, she helped me” (Khethiwe. Written, 12).

Khethiwe values the engagement and mathematical tips that she received from the SANCP after school mathematics club when she explains that the club “helped me, because in class I couldn’t get enough explanation (Khethiwe. Written, 14). So, I thought about Maths club” (Khethiwe. Written, 15).

In high school, Khethiwe continued to receive assistance from more knowledgeable people such as the school principal, her father, and learners in upper grades from another high school. She recounts that: “I got help from my father because he loves maths and he is able to do it, so even our Principal offered that he would do afternoon classes of maths for Grade 8 so I attended it so that’s how I got help in math” (Khethiwe. Spoken, 4), furthermore, “we even got help from [Vuyani High] girls that are coming to help us with maths every Tuesday” (Khethiwe. Spoken, 6).

Overall, Khethiwe explains that she is a learner who is highly engaged in mathematical activities and also understands her teacher’s teaching methods.

### *Alignment*

Khethiwe relates episodes of disalignment in mathematics in the past where she “couldn’t understand the difference between the signs of multiplication, subtraction and adding” (Khethiwe. Written, 5). Additionally, in Grade 7 she explains that she “used to struggle because it was a little bit hard because it was my first time seeing x’s and I couldn’t understand how to solve them” (Khethiwe. Written, 11). She however recounts getting assistance with alignment in mathematics activities “from my father because he loves maths and he is able to do it, so even our Principal offered that he would do afternoon classes of maths for Grade 8 so I attended it so that’s how I got help in maths” (Khethiwe. Spoken, 4).

Khethiwe’s narrative illustrates that her successful alignment with the various mathematics rules can be traced to the SANCP after school mathematics club where she explains that: “Maths club ... helped me, because in class I couldn’t get enough explanation (Khethiwe. Written, 14). So, I thought about Maths club” (Khethiwe. Written, 15).

### *Imagination*

Although Khethiwe expounds that she was a learner who struggled a lot in Grade 9, where she reflects that: “I couldn’t hear the teacher when he was teaching” (Khethiwe. Written, 18), she

imagines herself “doing maths, pure maths next year because I love maths more than maths lit because that’s the one I understand and love more than maths lit” (Khethiwe. Spoken, 7). Additionally, she imagines that mathematics “will help me because I, because I, because I don’t know, because I am not sure what I am going to be when I grow up, because I wanted to be a pilot first but am struggling with Geography so I decided not to be a pilot anymore, so I am not sure about the career now” (Khethiwe. Spoken, 9). She may not have settled on what she will study post high school but she seems to recognise the gatekeeper effect of mathematics.

### ***5.2.11.3 Summarising Khethiwe’s identity stories***

Khethiwe positions herself as a learner whose alignment in mathematics improved when she started attending the after school mathematics club. Her narrative about herself is as a learner who receives external assistance from various more knowledgeable people in the landscape of practice.

Furthermore, Khethiwe’s narrative about herself is as a learner who reveals an identity of struggling with mathematics in primary school and high school where she does not understand the teachers when they are teaching.

She imagines herself as a learner who will continue doing mathematics post the compulsory schooling stage.

### 5.2.12 Lisa: Narrative

Lisa's narrative illuminates how she relied on her FP teacher (2 utterances, TN1) for alignment in mathematics engagement and she further engages with mathematics outside her classroom (5 utterances, TN5) where she sought assistance from those around her; parents (3 utterances, TN4) and high school teachers (1 utterance, TN3). She enjoyed successful engagement in the FP (3 utterances, TN7-FP), IP (4 utterances, TN7-IP) and high school (3 utterances, TN7-HS), but she sometimes had to deal with difficult mathematics moments in FP (8, TN11-FP) and in the IP (5 utterances, TN11-IP). Interestingly, she does not speak about encountering any difficulties in high school (TN11-HS).

Lisa does not mention the after school mathematics club coordinators nor does she speak about the gatekeeper effect of mathematics, but she describes narratives of her imagination of future lifelong mathematics learning (3 utterances, TN16).

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Lisa's written and spoken stories.

Table 5.13 Lisa's narrative

| Written Story                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Narratives about the nature of mathematics                                                                                     | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p>2. I was confused by Maths. [TN11-FP] (E)</p> <p>6. Maths was a little hard in grade 2 than in grade 1. [TN11-FP] (E/I)</p> | <p>2. At first <u>[I was confused by Maths.*]</u> [TN11-FP] (E)</p> <p>3. I couldn't tell the difference between addition and subtraction but with the help of my parents and my teacher, I finally could tell the difference between the two. [TN10a, TN5] (E/A)</p> <p>7. <u>[During the first term I would get low marks and I would (get) feel bad about myself.*]</u> [TN11-FP] (I)</p> <p>9. I was good at maths until the last term. [TN7-FP] (A)</p> <p>10. In grade 3 and 4 I was still good at maths, a little less in grade 4 because of multiplication</p> | <p>1. I started school in grade 1 at Makhanda Primary and I was taught maths by Mrs [Q] - best teacher ever! [TN1a] (E)</p> <p>3. <u>[I couldn't tell the difference between addition and subtraction but with the help of my parents and my teacher, I finally could tell the difference between the two.*]</u> [TN10a, TN5, TN1a] (E/A)</p> <p>4. In the next year I went to grade 2. (E)</p> <p>5. I was really excited because it was my first time in grade 2, but all that excitement came to an end. (E)</p> <p>7. <u>[During the first term I would get low marks and I would (get) feel bad about myself.*]</u> [TN11-FP] (I)</p> |

|                                                   |                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                   | <p>and subtraction. [TN7-IP, TN11-IP] (A)</p> <p>11. I was new in those. (A)</p>                                                                                                                                                                       | <p>8. I ask my mom, who (was) is really good at maths to help me and a little while later, I was slowly getting there. [TN5] (E)</p> <p>12. In grade 5 2015 I went to a new school, S. Msholozzi Primary. (E)</p> <p>13. At first, I was shy because I never really knew anyone at that time. (E)</p> <p>14. I think it was in term 2 when my classmate, Lithemba went to another school. (E/I)</p> <p>15. Lithemba was a maths club member before he left and my teacher suggested that I go to the maths club class and replace Lithemba. [TN6a] (E)</p> <p>16. I asked my other classmate, Zimkhitha to accompany me because I was really scared that (the club coordinator) would chase me out of the maths club. [TN6a] (I)</p> <p>17. I got there and (the club coordinator) welcomed me. [TN6a] (I)</p> <p>18. I was shy at first but then I got eased up. (I)</p> <p>19. The maths club really helped improve my maths skills and I will be always grateful for that. [TN6a] (I)</p> |
| <b>Spoken Story: Interview</b>                    |                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Narratives about the nature of mathematics</b> | <b>Narratives about oneself as a maths learner</b>                                                                                                                                                                                                     | <b>Narratives of engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                   | <p>1. Ok, so in Grade 1 I don't really remember, but um, I used to have no knowledge of maths in Grade 1, <u>[I would ask my mother to help me after school, and she would help me with maths and then I got to understand*.]</u> [TN10a, TN4] (E)</p> | <p>1. ....I would ask my mother to help me after school, and she would help me with maths and then I got to understand. [TN4] (E)</p> <p>2. And then after Grade 1, I received a certificate for improving in maths. [TN10a, TN7-FP] (A)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>1. ...I would ask my mother to help me after school, and she would help me with maths and then I got to understand. [TN4] (E)</p> <p>3. Then ke, in Grade 2 I went to another school, and when I arrived there, I was shy, so I didn't really do well in school. [TN11-FP] (E)</p> <p>5. Grade 3, yah...I was good but not that good at maths. [TN11-FP, TN7-FP] (I)</p> <p>6. Then in grade 4, grade 4, I also had troubles with maths. [TN11-IP] (I)</p> <p>8. In Grade 5 I went to another school S. Msholozzi Primary, then yah I was good at maths there because I was comfortable in that school. [TN7-IP] (E)</p> <p>9. Then in Grade 6 too I was doing great in maths. [TN7-IP, TN10a] (E)</p> <p>11. Then in Grade 8, I think that I didn't really understand what the teacher taught, the teacher's style of teaching maths, so I failed maths in term 1, then in the other terms I improved. [TN3b, TN11-IP, TN10b, TN7-HS] (E/A)</p> <p>12. Then, now in Grade 9 getting help from learners from [Vuyani High], so I'm doing well in maths. TN7-HS, TN5] (E/A)</p> <p>13. I'm thinking of doing maths, not maths lit, because I want to do physical sciences, then I'm not too sure about the other subjects, but I will have to research. [TN10a, TN16] (I)</p> <p>14. I think that if I don't get a job then I will volunteer at schools, maybe primary schools or high</p> | <p>4. So I think it was in term 4, I got used to everything at that school and then I did well in maths. [TN7-IP] (E)</p> <p>5. [Grade 3, yah...I was good but not that good at maths*], then my maths teacher would ask me to stay after school, where she can help me with maths. [TN11-FP, TN1a] (E/I)</p> <p>6. [Then in Grade 4, Grade 4, I also had troubles with maths*], because it was my first time doing social sciences and natural sciences, so I used to focus on those subjects. [TN11-IP] (E)</p> <p>7. Then maths, so I went to my Grade 3 teacher and she would help me with maths, I used to go to her house on Saturdays, then she would help me with maths. [TN1a] (E)</p> <p>10. Then in Grade 7 I was introduced to solving for x and things like that, so I didn't really understand, especially because we were doing angles, and I wasn't really good at counting angles. [TN10b, TN11-IP] (E/A)</p> <p>12. [Then, now in Grade 9 getting help from learners from [Vuyani High], so I'm doing well in maths.*] [TN7-HS, TN5] (E)</p> <p>14. Yah, after school I will have to do maths in high school, but then after that I'm not sure what I'm going to do, but [I think that if I don't get a job then I will volunteer at schools, maybe primary schools or high schools to help children who are struggling with maths*] and I'm going to help them. [TN10a, TN16] (E/I)</p> |
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|  |                                                                             |  |
|--|-----------------------------------------------------------------------------|--|
|  | schools to help children who are struggling with maths. [TN10a, TN16] (E/I) |  |
|--|-----------------------------------------------------------------------------|--|

[\*] denotes a phrase extracted to be coded additionally elsewhere

### 5.2.12.1 Lisa's narrative and Solomon's strands

#### *Lisa's narrative about the nature of mathematics*

Lisa explains that she was a learner who was confused by mathematics in the past and adds that: "Maths was a little hard in grade 2 than in grade 1" (Lisa. Written, 6). In the interactive interview, Lisa did not share any thoughts about her stories about the nature of mathematics.

#### *Lisa's narrative about herself as a maths learner*

Early in the FP, Lisa describes herself as "good at maths" (Lisa. Written, 9). She continued describing herself as such in grades 3 and 4 where she writes that: "I was still good at maths, a little less in grade 4 because of multiplication and subtraction" (Lisa. Written, 10).

She explains that she was a learner who was sometimes confused with mathematics, but she got assistance when she writes that: "At first I was confused by Maths (Lisa. Written, 2). I couldn't tell the difference between addition and subtraction but with the help of my parents and my teacher, I finally could tell the difference between the two" (Lisa. Written, 3).

Lisa further reveals that: "During the first term I would get low marks" and this would make her "feel bad about myself" (Lisa. Written, 7).

In the interactive interview, Lisa describes herself as not having necessary mathematical knowledge when she commenced primary school. She reflects that, "in Grade 1 I don't really remember, but um, I used to have no knowledge of maths in Grade 1, I would ask my mother to help me after school, and she would help me with maths and then I got to understand" (Lisa. Spoken, 1). She explains that she was a learner who was not always a confident and potential participant in mathematics when she narrates that "... in Grade 2 I went to another school, and when I arrived there, I was shy, so I didn't really do well in school" (Lisa. Spoken, 3).

As someone who was not good in mathematics then, Lisa would seek assistance from her mother and she eventually improved and became a competent mathematics learner. She later confirmed that: "In Grade 5 I went to another school S. Msholozzi Primary, then yeah I was good at maths there because I was comfortable in that school" (Lisa. Spoken, 8). The trend continued in the next grade where she confirms that "... in Grade 6 too I was doing great in maths" (Lisa. Spoken, 9).

Later on in Grade 7, the introduction of new concepts vexed her and dented her participation in mathematics as reflects in the assertion that, "...in Grade 7 I was introduced to solving for  $x$  and things like that, so I didn't really understand, especially because we were doing angles, and I wasn't really good at counting angles" (Lisa. Spoken, 10). She further explains that her first year in high school was not any better in terms of improving her stories about herself as a mathematics learner as she performed poorly at first. The new environment that she was entering was made worse by the teaching pedagogy of her mathematics teacher. She complained that "...in Grade 8, I think that I didn't really understand what the teacher taught, the teacher's style of teaching maths, so I failed maths in term 1..." (Lisa. Spoken, 11). However, she says that when she got used to the teaching style of the teacher, "...in the other terms I improved" (Lisa. Spoken, 11). Her stories about herself as a mathematics learner seemed to improve from there onwards as she later on underscored that: "I'm thinking of doing maths, not maths lit, because I want to do physical sciences, then I'm not too sure about the other subjects, but I will have to research" (Lisa. Spoken, 13).

#### *Lisa's narrative of her engagement in mathematics*

Lisa begins her written story by mentioning her relationship with her teacher: "I started school in grade 1 at Makhanda Primary and I was taught maths by Mrs [P] - best teacher ever!" (Lisa. Written, 1). When she moved to grade 2, "all that excitement came to an end" (Lisa. Written, 5) because "Maths was a little hard in grade 2 than in grade 1" (Lisa. Written, 6).

She therefore had to "ask my mom, who is really good at maths to help me and a little while later, I was slowly getting there" (Lisa. Written, 8).

Lisa writes that: "In grade 5 2015 I went to a new school, S. Msholozzi Primary" (Lisa. Written, 12) where she later joined the after school mathematics club. Although she was shy at first as a new member of the club, she later eased up and participated in the various mathematics activities. She later on expounded that: "The maths club really helped improve my maths skills and I will be always grateful for that" (Lisa. Written, 19).

Her engagement in mathematics also had some difficulties: "I couldn't tell the difference between addition and subtraction but with the help of my parents and my teacher, I finally could tell the difference between the two" (Lisa. Written, 3).

When she transferred to a new school, she explained that: "At first, I was shy because I never really knew anyone at that time" (Lisa. Written, 13), and that affected her performance until she joined the after school mathematics club.

In the spoken narrative, Lisa stated that she involved other people in her learning of mathematics. In Grade 1 when she had *no knowledge of maths*, she relied on her mother to help her with any mathematical work, and later in Grade 3 she got assistance from her teacher. She explained that, “...I would ask my mother to help me after school, and she would help me with maths and then I got to understand” (Lisa. Spoken, 1), and later: “I was good but not that good at maths, then my maths teacher would ask me to stay after school, where she can help me with maths” (Lisa. Spoken, 5). Lisa expounds that the engagement with her teacher escalated into out of school extra tutorials where she states that: “I went to my Grade 3 teacher and she would help me with maths, I used to go to her house on Saturdays, then she would help me with maths” (Lisa. Spoken, 7).

Lisa acknowledges that she was *not that good at mathematics* and engaged more knowledgeable others in her mathematics work as she states that, “now in Grade 9 getting help from learners from [Vuyani High], so I’m doing well in maths” (Lisa. Spoken, 12).

Although Lisa imagines doing mathematics post the compulsory schooling stage in Grade 9 as indicated by the statement that, “... after school I will have to do maths in high school...” (Lisa. Spoken, 14), she was not sure of what she wanted to do thereafter “...then after that I’m not sure what I’m going to do” (Lisa. Spoken, 14). Interestingly, she imagines continuing her engagement in mathematical activities, albeit in a different capacity. She explains that: “...I think that if I don’t get a job then I will volunteer at schools, maybe primary schools or high schools to help children who are struggling with maths and I’m going to help them” (Lisa. Spoken, 14).

Her successful engagement in mathematical activities was not without its own impediments as she narrates that, “in Grade 4, I also had troubles with maths, because it was my first time doing social sciences and natural sciences, so I used to focus on those subjects” (Lisa. Spoken, 6). The introduction of more learning areas in the Intermediate Phase seemed to temporarily distract her from focusing on mathematics.

In high school, her hitherto successful engagement in mathematics suffered another setback. She reflects that, “...in Grade 8, I think that I didn’t really understand what the teacher taught, the teacher’s style of teaching maths, so I failed maths in term 1, then in the other terms I improved” (Lisa. Spoken, 11).

### ***5.2.12.2 Lisa's narrative and modes of belonging***

#### *Engagement*

Lisa indicates that her mathematics involvement went beyond the school classroom as she explains that: "I would ask my mother to help me after school, and she would help me with maths and then I got to understand" (Lisa. Spoken, 1). In FP "I couldn't tell the difference between addition and subtraction but with the help of my parents and my teacher, I finally could tell the difference between the two" (Lisa. Written, 3). She also narrates how her Grade 3 teacher would offer her extra mathematics assistance: "I was good but not that good at maths, then my maths teacher would ask me to stay after school, where she can help me with maths" (Lisa. Spoken, 5).

Lisa recounts how the transition to the IP affected her successful engagement in mathematics that, "in Grade 4, I also had troubles with maths, because it was my first time doing social sciences and natural sciences, so I used to focus on those subjects" (Lisa. Spoken, 6). She probably failed to balance the increased number of subjects but she showed agency by seeking assistance, "so I went to my Grade 3 teacher and she would help me with maths, I used to go to her house on Saturdays, then she would help me with maths" (Lisa. Spoken, 7).

She encountered obstacles in her mathematics engagement in Grade 7 when she was introduced to algebra where she explains that: "I was introduced to solving for x and things like that, so I didn't really understand, especially because we were doing angles, and I wasn't really good at counting angles" (Lisa. Spoken, 10).

#### *Alignment*

Lisa relates how parental involvement assisted her to break through some obstacles that she came across in her mathematical journey when she writes that, "I couldn't tell the difference between addition and subtraction but with the help of my parents and my teacher, I finally could tell the difference between the two" (Lisa. Written, 3) and "In grade 3 and 4 I was still good at maths, a little less in grade 4 because of multiplication and subtraction" (Lisa. Written, 10).

She describes herself as a learner who faced challenges in Grade 7 and on the transition to high school when she states that:

Then in Grade 7 I was introduced to solving for x and things like that, so I didn't really understand, especially because we were doing angles, and I wasn't really good at counting angles. Then in Grade 8, I think that I didn't really understand what the teacher taught, the

teachers' style of teaching maths, so I failed maths in term 1, then in the other terms I improved (Lisa. Spoken, 10-11).

Interestingly, with further after school mathematics assistance “from learners from [Vuyani High] I’m doing well in maths” (Lisa. Spoken, 12) and she has announced her intention to choose mathematics in Grade 10.

### *Imagination*

Lisa reflects tough experiences in primary school mathematics, where she relates that: “I would get low marks and I would (get) feel bad about myself” (Lisa. Written, 7). She continues that: “I was good but not that good at maths, then my maths teacher would ask me to stay after school, where she can help me with maths” (Lisa. Spoken, 5), and this helped to improve her mathematics engagement.

Lisa looks back at how the SANCP after school mathematics club “really helped improve my maths skills and I will be always grateful for that” (Lisa. Written, 19). She proceeds to then explain that it transformed her from being shy into a competent and confident learner who would later choose to do mathematics, “not maths lit, because I want to do physical sciences, then I’m not too sure about the other subjects, but I will have to research” (Lisa. Spoken, 13).

She further imagines herself as a volunteer mathematics tutor where she narrates that: “I think that if I don’t get a job then I will volunteer at schools, maybe primary schools or high schools to help children who are struggling with maths” (Lisa. Spoken, 14).

### **5.2.12.3 Summarising Lisa’s identity stories**

Lisa stories herself as a learner who was competent in mathematics and even received a certificate for improving in the subject. While she says she was competent in mathematics, she stories herself as a learner who experienced the subject as a little hard and confusing, and she would get low marks and feel bad about herself.

Lisa’s narrative about herself is as a learner whose introduction to the after school mathematics club improved her mathematics skills and she imagines that she will always be grateful for that.

Her identity of herself as an active engager in mathematics shifts in high school as she was not familiar with the teacher’s teaching style and she failed mathematics in Grade 8.

Her imagined trajectory of her lifelong engagement and alignment in mathematics is as a volunteer at primary schools or high schools where she would help learners who struggle with the subject.

### 5.2.13 Funeka: Narrative

Although Funeka explains that she enjoyed mathematics in the FP (4 utterances, TN7-FP) and high school (3 utterances, TN7-HS), the thematic narratives that feature prominently in her narrative relate to her participation in the after school mathematics clubs in the IP (10 utterances, TN6) where she describes how she benefited from the club coordinator's pedagogical practice (2 utterances, TN2). She also speaks about receiving external assistance from learners in higher grades (3 utterances, TN5) and her parents (1 utterance, TN4).

She further explains the difficult episodes, where she struggled in negotiating the mathematics challenges in the FP (1 utterance, TN11-FP), IP (7 utterances, TN11-IP) and high school (6 utterances, TN11-HS).

Funeka recognises the gatekeeper effect of mathematics (1 utterance, TN9) and intends to continue doing the subject in future (1 utterance, TN16) as she imagines working as a doctor one day.

Lastly, Funeka does not speak about her primary (TN1) or high school (TN3) teachers in her narrative.

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Funeka's written and spoken stories.

Table 5.14 Funeka's narrative

| Written Story                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Narratives about the nature of mathematics                                                                                                                                                                                                                                                      | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                    | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>11. In 2017 I was doing grade 7 and maths was very very tough because grade 7 is not such an easy grade. [TN11-IP] (I)</p> <p>14*. In grade 8 in 2018 I was doing maths which was not that hard but it was understandable and enjoyable but sometimes it was very tricky... [TN7-HS] (I)</p> | <p>1. I remember in grade 1 in 2011 I was struggling with my maths. [TN11-FP] (I)</p> <p>2*. I couldn't find the difference between the signs of addition, subtraction, multiplication and division. [TN10b] (A)</p> <p>5*. I was struggling again because maths was not the same we were working with big</p> | <p>2. <u>[I couldn't find the difference between the signs of addition, subtraction, multiplication and division.*]</u> [TN10b] (A)</p> <p>3. As time go by my mom was helping me by bringing bottle lids so that she can help me work. [TN4] (E)</p> <p>4. After I was able to know the signs. [TN10a] (E/A)</p> <p>5. When I started in the intermediate phase <u>[I was struggling again because maths was not the same we were working</u></p> |

|                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>15*. maths is a little bit hard especially when it comes to geometry. [TN11-HS] (E)</p> | <p>numbers. [TN10b, TN11-IP] (E/A)</p> <p>5*. I was confused when it comes to be using the column when multiplying. [TN10b, TN11-IP] (E/A)</p> <p>8. I made my final decision to attend the club because I really need help. [TN6a] (E)</p> <p>10. After joining the club I saw that my results are changing and they are increasing. [TN6a] (I)</p> <p>13. At the end of the year I was happy with maths results thanks to the club. [TN6a] (I)</p> | <p><u>with big numbers*]</u> and <u>[I was confused when it comes to be using the column when multiplying.*]</u> [TN10b, TN11-IP] (E/A)</p> <p>6. But we were asked if we want to attend the maths club with (the club coordinator). [TN6a] (E)</p> <p>7. I didn't want to go to the maths club because after school I was getting hungry and in the club we were doing some work for an hour. [TN6a] (E)</p> <p>9. So I attended the club so things went better because (the club coordinator) was keeping asking which chapter we are struggling with and help us with that by playing games. [TN6a] (E)</p> <p>12. My marks in maths were decreasing but the club helped I'm so grateful because in 2017 (the club coordinator) was the one who was controlling the club but she kept on giving us tests which really helped a lot. [TN6a] (E)</p> <p>14. <u>[In grade 8 in 2018 I was doing maths which was not that hard but it was understandable and enjoyable but sometimes it was very tricky*]</u>, but we getted (got) help from learners from [Vuyani High] who were doing grade 10 that year they really helped their help is appreciated, they were coming every Tuesday just like the club in primary. [TN7-HS, TN5] (I)</p> <p>15. Now I'm doing grade 9 and <u>[maths is a little bit hard especially when it comes to geometry*]</u> but <u>[the [Vuyani High] girls are helping and I think there will be change so that I will choose Pure maths in grade 10. *]</u> [TN11-HS, TN5] (E)</p> |
|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                         | 15*. the [Vuyani High] girls are helping and I think there will be change so that I will choose Pure maths in grade 10. [TN5] (E)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Spoken Story: Interview</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Narratives about the nature of mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Narratives about oneself as a maths learner</b>                                                                                      | <b>Narratives of engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <p>1. <u>[Okay, in Grade 1 maths was very easy because we were using bottle lids to count when we were doing addition or subtraction.*]</u> [TN7-FP, TN10a] (E/A)</p> <p>2. It was not that hard. [TN7-FP] (E)</p> <p>4. In Grade 4, the maths started to be hard because <u>[we were no longer using the bottle lids to count and then we joined the maths club in 2014.*]</u> [TN11-IP, TN6a] (E)</p> <p>7*. It was hard in Grade 7 because we were doing division and multiplication with big numbers. [TN11-IP] (E/A)</p> <p>8. It was very hard. [TN11-HS] (E)</p> <p>9. In Grade 8 it was very hard. [TN11-HS] (E/A)</p> <p>13. Most careers need maths. [TN9] (A)</p> | <p>11. I'll be doing maths, pure maths. [TN10a] (I)</p> <p>12. I think maths will help me because I want to be a doctor. [TN16] (I)</p> | <p>1. Okay, in Grade 1 maths was very easy because we were using i-bottle lids to count when we were doing addition or subtraction. [TN7-FP, TN10a] (E/A)</p> <p>3. Then in Grade 2, it was the same as Grade 1 but we were using numbers like hundreds. [TN7-FP] (E/A)</p> <p>4. ... we were no longer using the bottle lids to count and then we joined the maths club in 2014. [TN6a] (E)</p> <p>5. Then (the club coordinator) used to teach us where we are counting to use i-cards. [TN2] (E)</p> <p>6. And then we started maths club in Grade 4 and she was giving us the cards and dice to count and then we went to Grade 6, it was the same. [TN2, TN6a] (E)</p> <p>7. <u>[It was hard in Grade 7 because we were doing division and multiplication with big numbers.*]</u> [TN11-IP] (EA)</p> <p>9. <u>[In Grade 8 it was very hard*]</u> because we were doing something new like solving x in algebra and all this stuff. [TN10b, TN11-HS] (E/A)</p> <p>10. Now in Grade 9 it is not that hard but sometimes it is very hard because we are doing i-trinomial and all that stuff. [TN7-HS, TN11-HS] (E/A)</p> |

[\*] denotes a phrase extracted to be coded additionally elsewhere

### ***5.2.13.1 Funeka's narrative and Solomon's strands***

#### *Funeka's narrative about the nature of mathematics*

At the end of primary school in Grade 7, Funeka writes that she found that, “maths was very, very tough because grade 7 is not such an easy grade” (Funeka. Written, 11). She continued that, in high school, “maths is a little bit hard especially when it comes to geometry” (Funeka. Written, 15), but explains that when she started high school in Grade 8 she discovered that some mathematical concepts were “not that hard, but it was understandable and enjoyable but sometimes it was very tricky” (Funeka. Written, 14).

In her spoken story, Funeka describes FP mathematics as “not that hard” (Funeka. Spoken, 2) but “very easy because we were using bottle lids to count when we were doing addition or subtraction” (Funeka. Spoken, 1).

However, mathematics along the journey was different, she narrates that: “In Grade 4, the maths started to be hard because we were no longer using the bottle lids to count and then we joined the maths club in 2014” (Funeka. Spoken, 4). Furthermore, it “was hard in Grade 7 because we were doing division and multiplication with big numbers (Funeka. Spoken, 7). She explains that the trend continues in high school where: “In Grade 8 it was very hard” (Funeka. Spoken, 9).

Although the subject is hard, Funeka also realises its gatekeeper effect in life. She explains that “most careers need maths” (Funeka. Spoken, 13) and she even chose to persevere with it because she wants to study medicine in university.

#### *Funeka's narrative about oneself as a maths learner*

Funeka explains in her written narrative that in the past she “was struggling with my maths” (Funeka. Written, 1) and she could not “find the difference between the signs of addition, subtraction, multiplication and division” (Funeka. Written, 2). She continued to struggle in the intermediate phase, “because maths was not the same, we were working with big numbers and I was confused when it comes to be using the column when multiplying” (Funeka. Written, 5).

Funeka reflects that when she was asked to join the after school mathematics club: “I made my final decision to attend the club because I really need help” (Funeka. Written, 8) and after engaging in “the club, I saw that my results are changing and they are increasing” (Funeka. Written, 10). She continues to relate that: “At the end of the year I was happy with maths results thanks to the club” (Funeka. Written, 13).

Her decision in the spoken narrative to choose to pursue a career that requires mathematics as a prerequisite entry requirement illustrates that she is a competent mathematics learner. In this regard she explains that: “I’ll be doing maths, pure maths (Funeka. Spoken, 11). I think maths will help me because I want to be a doctor” (Funeka. Spoken, 12).

### *Funeka’s narrative of her engagement in mathematics*

Funeka writes in her story that engagement in mathematics was difficult for her as she was unable to “find the difference between the signs of addition, subtraction, multiplication and division” (Funeka. Written, 2). This continued in the IP where she reveals that: “I was struggling again because maths was not the same, we were working with big numbers and I was confused when it comes to be using the column when multiplying” (Funeka. Written, 5).

She recalls that when the SANCP after school mathematics club was introduced: “I didn’t want to go to the maths club because after school I was getting hungry and in the club we were doing some work for an hour” (Funeka. Written, 7) but later: “I attended the club, so things were better because (the club coordinator) was keeping asking which chapter we are struggling with and help us with that by playing games” (Funeka. Written, 9).

Funeka tells a story of acknowledging external assistance in her engagement in mathematics practice when she writes that:

In Grade 8 in 2018 I was doing maths which was not that hard but it was understandable and enjoyable but sometimes it was very tricky, but we getted [sic] help from learners from [Vuyani High] who were doing Grade 10 that year they really helped their help is appreciated, they were coming every Tuesday just like the club in primary. Now I’m doing Grade 9 and maths is a little bit hard especially when it comes to geometry but the [Vuyani High] girls are helping and I think there will be change so that I will choose Pure maths in Grade 10 (Funeka. Spoken, 14-15).

In the spoken narrative, she restates that she was a learner who was actively engaged in mathematics in the FP, where she explains that, “in Grade 2, it was the same as Grade 1 but we were using numbers like hundreds (Funeka. Spoken, 3), ... we were no longer using the bottle lids to count and then we joined the maths club in 2014” (Funeka. Spoken, 4). The engagement in mathematical activities continued in the after school mathematics clubs and at this stage as she explained earlier, mathematics was easy.

She however referred to difficult episodes in mathematics at the end of primary school and in high school. She reflects that, “It was hard in Grade 7 because we were doing division and multiplication with big numbers” (Funeka. Spoken, 7), then “in Grade 8 it was very hard because we were doing something new like solving  $x$  in algebra and all this stuff” (Funeka.

Spoken, 9). Although she was still actively participating in mathematics, at this stage she was encountering difficulties.

Funeka shows that she was a learner who was resilient and confident when she expounds that, “now in Grade 9 it is not that hard but sometimes it is very hard because we are doing trinomial and all that stuff” (Funeka. Spoken, 10).

### ***5.2.13.2 Funeka’s narrative and modes of belonging***

#### *Engagement*

Funeka conceptualises FP mathematics as “very easy because we were ...doing addition or subtraction” (Funeka. Spoken, 1) and there was intensive use of manipulatives which was even fun. She also adds that “my mom was helping me by bringing bottle lids so that she can help me work” (Funeka. Written, 3). But in the IP, she points out that: “I was struggling again because maths was not the same we were working with big numbers and I was confused when it comes to be using the column when multiplying” (Funeka. Written, 5).

When the SANCP after school club was announced, Funeka “didn’t want to go to the maths club because after school I was getting hungry and in the club we were doing some work for an hour” (Funeka. Written, 7), but she conceptualised the club as a place where one could get mathematics assistance, so “I made my final decision to attend the club because I really need help” (Funeka. Written, 8).

She explains that the club coordinator did not impose what learners would learn but she “was keeping asking which chapter we are struggling with and help us with that by playing games” (Funeka. Written, 9). Funeka recounts that her “marks in maths were decreasing, but the club helped, I’m so grateful because in 2017 (new club coordinator) was the one who was controlling the club but she kept on giving us tests which really helped a lot” (Funeka. Written, 12).

Nkosi was a learner who started experiencing obstacles in participation in Grade 7 “because we were doing division and multiplication with big numbers” (Funeka. Spoken, 7). These obstacles continued in high school, where Grade 8 was very hard “because we were doing something new like solving  $x$  in algebra and all this stuff” (Funeka. Spoken, 9), but now in Grade 9 “it is not that hard but sometimes it is very hard because we are doing trinomial and all that stuff” (Funeka. Spoken, 10). She also adds that, “maths is a little bit hard especially

when it comes to geometry but the [Vuyani High] girls are helping and I think there will be change so that I will choose pure maths in Grade 10” (Funeka. Spoken, 15).

Overall, Funeka chronicles narratives of positive engagement with mathematics in her trajectory from primary to high school, passing through the SANCP after school mathematics club.

### *Alignment*

Funeka narrates her inability to sometimes align and coordinate her energy and activities (Wenger, 1998) to “find the difference between the signs of addition, subtraction, multiplication and division” (Funeka. Written, 2). She continues that: “I was struggling again because maths was not the same we were working with big numbers and I was confused when it comes to be using the column when multiplying” (Funeka. Written, 5).

The disalignment in mathematics activities continued in high school where mathematics was hard “because we were doing something new like solving  $x$  in algebra and all this stuff” (Funeka. Spoken, 9).

Although she chronicles episodes of disalignment, this did not affect her affinity for mathematics as illustrated in the next section.

### *Imagination*

Funeka recounts that she was a learner who was “struggling with...maths” (Funeka. Written, 1) in the past but her failure to align and engage successfully was thankfully ameliorated after joining the SANCP after school mathematics club as her results started “changing, and they are increasing” (Funeka. Written, 10). She continues that: “At the end of the year I was happy with maths results thanks to the club” (Funeka. Written, 13).

She reflects that high school mathematics is both challenging and enjoyable when she writes that: “In grade 8 in 2018 I was doing maths which was not that hard but it was understandable and enjoyable but sometimes it was very tricky, but we getted [sic] help from learners from [Vuyani High] who were doing grade 10 that year, they really helped, their help is appreciated, they were coming every Tuesday just like the club in primary” (Funeka. Written, 14).

Despite the intermittent challenges she encountered in the landscape of mathematics practice, Funeka imagines that in future she will “be doing maths, pure maths” (Funeka. Spoken, 11) because she thinks that mathematics “will help me because I want to be a doctor” (Funeka. Spoken, 12).

### ***5.2.13.3 Summarising Funeka's identity stories***

Funeka positions herself as a learner who struggled with mathematics and would sometimes seek assistance from her mother. Her narrative about herself is as a learner who was confused when it came to multiplication of big numbers and using the columns method for multiplication in Grade 7.

She narrates a story of herself as a learner whose results later shifted, and she started improving in her performance when she joined the SANCP after school mathematics club. She further stories herself as a learner that values the assistance that she received from the after school mathematics club.

Funeka positions herself as a learner who perceived mathematics as hard in high school, she nonetheless chose to continue doing it post the compulsory schooling stage because she imagines herself studying medicine, a profession that requires mathematics.

### 5.2.14 Lindelwa: Narrative

Lindelwa speaks highly of the external assistance (1 utterance, TN5) that she received from friends and the after school mathematics club (19 utterances, TN6) and from her parents at home (4 utterances, TN4) which likely made her enjoy mathematics at the IP (2 utterances, TN7-IP) and high school (3 utterances, TN7-HS). She also speaks about the assistance from her primary school teachers (2 utterances, TN1) and the after school mathematics club coordinator (1 utterance, TN2).

Although she experienced mathematics difficulties in the FP (3 utterances, TN11-FP) and in high school (5 utterances, TN11-HS), she continues to imagine her lifelong future in mathematics (3 utterances, TN16) where she intends to be a scientist. Lindelwa does not speak about TN4, TN6, TN11 and TN11-IP at all.

The table presents the codes of Wenger's (1998) modes of belonging and Solomon's (2009) strands and the thematic narratives from Lindelwa's written and spoken stories.

Table 5.15 Lindelwa's narrative

| Written Story                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Narratives about the nature of mathematics                                                                            | Narratives about oneself as a maths learner                                                                                                                                                                                                                                                                                                                        | Narratives of engagement in mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 3. maths isn't that hard and it is not about getting the right answer, but it was about understanding. [TN10] (I/E/A) | <p>2. At first I never liked maths it was the only subject I hated. [TN11-FP] (I)</p> <p>5. Since then I loved maths more and more, it became my favourite subject. [TN6a, TN10a, TN7-IP] (I)</p> <p>8. In everything I did that has something to do with Maths I would think of (the club coordinator) and (the club coordinator)'s words. [TN10a, TN6] (E/I)</p> | <p>1. When I started learning in S. Msholozzi Primary, I joined the Maths Club but I didn't join it my teacher...took me to the Maths Club. [TN6a] (E)</p> <p>3. But when I joined the Maths club it made me realise that <u>maths isn't that hard and it is not about getting the right answer, but it was about understanding*</u> it, making everything fun and coming up with great new ideas on how to solve maths problems. [TN6a, TN10a] (E/A/I)</p> <p>4. I've been attending the Maths Club since 2013/2014 until 2017. [TN6a] (E)</p> <p>6. And guess what all the years that I have been attending the club I was getting certificates for maths because I was one of the Top learners in Maths. [TN6a, TN10a] (E/A)</p> <p>7. What I loved about Maths clubs is that (the club coordinator) and (the club coordinator)</p> |

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                        | <p>gave us time and always used this words “Make Maths Fun”. [TN6a] (E)</p> <p>9. I really appreciate everything that (the club coordinator) and (the club coordinator) did for me, because (if) they did not start the clubs I would be hating and failing maths. [TN6a, TN10a] (E/I)</p> <p>10. One day I will make them proud of me.(I)</p> <p>11. Now I am in High School things are tough because they are not there to help us and inspire us. [TN6a, TN11-HS] (E)</p> <p>12. But still trying to work hard and learn fast because the skills we developed from their Maths Clubs. [TN7-HS, TN10a, TN6a] (E/I)</p> <p>13. But we still need and want the Maths clubs to start again if that’s possible. [TN6a] (E/I)</p> <p>14. But still I appreciate everything that Maths Clubs have done for me. [TN6a] (I)</p> |
| <b>Spoken Story: Interview</b>                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Narratives about the nature of mathematics</b>                                                                                                                                                                                                                                        | <b>Narratives about oneself as a maths learner</b>                                                                                                                                                                                                                                                                                                                                                                                     | <b>Narratives of engagement in mathematics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>7. it was tough. [TN10b] (E)</p> <p>8. it’s very tough. [TN10b] (E)</p> <p>11. Grade 9 is still tough it’s tough. [TN10b] (E)</p> <p>12. I’m going to do maths, because if I do maths there are many opportunities that I have and I think maths, maths is better than maths lit.</p> | <p>1. Ok I was struggling with maths. [TN10b] (E)</p> <p>3. ... I was struggling with maths... [TN10b] (E)</p> <p>4. I started getting level 6 level 5 yah, because at first I was getting level 3, so yah it helped me a lot. [TN6a, TN7-IP] (I)</p> <p>6. when I’m struggling with maths I just think of the fun things we did, then you know use them to mix fun and maths and don’t make everything like it’s tough, yah those</p> | <p>1. It wasn’t in Grade 1 it was Grade 2, I think it started with my class teacher from primary school [<u>Ok I was struggling with maths*</u>] and she said I must stay, it was on a Tuesday, she said I must stay back when school is out. [TN10b, TN11-FP, TN1a] (E)</p> <p>2. I’m staying after school, then we went to the office and played some games that made us understand maths better and made maths fun. [TN1a, TN6a] (E)</p> <p>3. And then I think it was in Grade 2 when it was about in June or something, then (the club coordinator) arrived, from then it was fun, then <i>bone, ndfumai imarks I beter then icala</i>, [Translation – see, my marks are better after] because [I was struggling with maths*], then it was better. [TN11-FP, TN6, TN2] (E/I)</p>                                     |



|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>[TN10a, TN16] (I)</p> | <p>years it was fun. [TN6a] (E/I)</p> <p>7. First year I came I was a bit scared, <u>[it was tough*]</u>, because I think in the first term I got a level 5 in maths, it was tough, yeoh, and I was new in high school..., I was scared I was so scared. [TN10b, TN11-HS] (E)</p> <p>11. This year yeah, <u>[Grade 9 is still tough it's tough*]</u> but I'm trying, and I'm hoping to get things better. [TN11-HS] (E)</p> <p>12. Yeah, ha, <u>[I'm going to do maths, because if I do maths there are many opportunities that I have and I think maths, maths is better than maths lit.*]</u> [TN10a, TN16] (I)</p> | <p>5. Then it was in Grade 2, Grade 3, Grade 4, Grade 5, Grade 6 until Grade 7, I was with (the club coordinators). [TN6a] (E)</p> <p>6. I think (the club coordinator) arrived maybe, I can't remember but it was in 2014 or 2015 but yah I really appreciate their help, because even now sometimes <u>[when I'm struggling with maths I just think of the fun things we did, then you know use them to mix fun and maths and don't make everything like it's tough, yah those years it was fun.*]</u> [TN6a] (E/I)</p> <p>8. Then term 2 I got a level 4, then I met with the others, and then ah, we talked about hey guys <u>[it's very tough*]</u> and then we came up with thing, Yeoh guys let's make a WhatsApp group or something you know. [TN11-HS, TN5] (E)</p> <p>9. And then you know we remembered the things of old and the others, but yeah it was all of us and others at school, there wasn't a maths club, but we remembered things we did at school.] [TN10a] (E/I)</p> <p>10. Then term 4 I got level 5, but yah I tried. [TN7-HS] (E)</p> <p>13. Yeah, you know, and getting all those methods is not hard, it's quite an easy thing, if you just concentrate. [TN10a, TN11-HS] (E)</p> <p>14. I don't know maybe, I can say if we keep on seeing each other like this in this maths club, I think this thing is just a u know, I do it with hope/trust so that one day, like yah, maybe I'll be a scientist and then I'll get level 7s mostly, because I want to study at Rhodes, so you know I have to work hard. [TN16] (E)</p> <p>15. So, if we keep coming here and we get those textbooks yah it really helps. [TN5, TN6a] (I)</p> <p>16. Yeah get a Grade 9 textbook and it really helps as sometimes in class you don't really understand the teachers and then you get home you open the textbook and you see it the other way the teacher was telling you. [TN3b] (E)</p> |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|  |  |                                                                                                                                                                          |
|--|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | 17. So, I just hope in the future we keep on coming together like this so we trust each other, that's why maths becomes something nice, without difficulty. [TN7-HS] (I) |
|--|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[\*] denotes a phrase extracted to be coded additionally elsewhere

#### **5.2.14.1 Lindelwa's key narrative and Solomon's strands**

##### *Lindelwa's narrative about the nature of mathematics*

Lindelwa explains that mathematics “isn’t that hard and it is not about getting the right answer, but it was about understanding” (Lindelwa. Written, 3) the concepts.

She did not describe the nature of mathematics in primary school in her narrative. But in high school she explains that she was a learner who believes that “Grade nine is still tough, it’s tough but I’m trying, and I’m hoping to get things better” (Lindelwa. Spoken, 11). She does not let the difficulty reduce her mathematical affinity and the way she values the subject. She further relates that mathematics has a gatekeeper effect in life, and she imagines that it determines the kind of life that one can live in future. She gives credence to this assertion when she states that: “I’m going to do maths, because if I do maths there are many opportunities that I have and I think maths, maths is better than maths lit” (Lindelwa. Spoken, 12). She believes that another aspect of mathematics is that it is superior when compared to Mathematical Literacy.

##### *Lindelwa's narrative about herself as a maths learner*

Lindelwa describes herself as a learner who “never liked maths, it was the only subject I hated” (Lindelwa. Written, 2), but she later recounts that from the time she joined the after school mathematics club, “I loved maths more and more, it became my favourite subject” (Lindelwa. Written, 5). She continued to explain that: “In everything I did that has something to do with Maths I would think of (the club coordinator’s) words” (Lindelwa. Written, 8). She explains that the mathematics coordinators’ slogan, “Make Maths Fun” (Lindelwa. Written, 7), stuck with her and she would invoke it in the times of mathematics difficulties.

In the spoken narrative, Lindelwa describes herself as a learner who struggled, and was scared of mathematics at some point in high school. She points out that: “First year I came, I was a bit scared, it was tough, because I think in the first term I got a level 5 in maths, it was tough, and I was new in high school..., I was scared I was so scared” (Lindelwa. Spoken, 7).

It seems her fear of mathematics was resolved when she and some of her friends decided to form an after school mathematics study group. She explains that in "... term 2 I got a level 4, then I met with the others, and then ah, we talked about hey guys its very tough and then we came up with thing, Yeoh guys let's make a WhatsApp group or something you know" (Lindelwa. Spoken, 8).

*Lindelwa's narrative of her engagement in mathematics*

Although Lindelwa identifies herself as a learner who hated mathematics in the past, she reflects in her written narrative that, "when I joined the Maths club it made me realise that maths isn't that hard and it is not about getting the right answer, but it was about understanding it, making everything fun and coming up with great new ideas on how to solve maths problems" (Lindelwa. Written, 3), and since that time, "I loved maths more and more, it became my favourite subject" (Lindelwa. Written, 5).

She reveals that "all the years that I have been attending the club I was getting certificates for maths because I was one of the Top learners in Maths" (Lindelwa. Written, 6). She tells of a story of the after school mathematics club, where she explains that, what she "loved about Maths clubs is that (the club coordinators) gave us time and always used these words 'Make Maths Fun'" (Lindelwa. Written, 7). One of the ethos of the SANCP after school mathematics clubs was to allow learners to enjoy mathematics. Lindelwa therefore reveals that she appreciates "everything that (the club coordinators) did for me, because if they did not start the clubs I would be hating and failing maths" (Lindelwa. Written, 9).

Although the after school mathematics clubs were discontinued at the end of her primary school, Lindelwa still feels that she needs the assistance that she used to receive:

Now I am in High School things are tough because they are not there to help us and inspire us (Lindelwa. Written, 11). But still trying to work hard and learn fast because the skills we developed from their Maths Clubs (Lindelwa. Written, 12). But we still need and want the Maths clubs to start again if that's possible (Lindelwa. Written, 13). But still I appreciate everything that Maths Clubs have done for me (Lindelwa. Written, 14).

Lindelwa reflects that she was a learner who struggled with engagement in mathematics in the past. She spells out that because she "was struggling with maths," her Grade 2 teacher suggested that she "must stay back when school is out" (Lindelwa. Spoken, 1) for some extra mathematical assistance. The teacher then used innovative methods to help Lindelwa enjoy mathematics. She expounds that "after school...we went to the office and played some games that made us understand maths better and made maths fun" (Lindelwa. Spoken, 2). From the after school activities that she did with her teacher, she further hails the coming in of the

SANCP after school mathematics clubs: “I think it was in Grade 2 when it was about in June or something, then (the club coordinator) arrived, from then it was fun, then, see, my marks are better after because I was struggling with maths, then it was better” (Lindelwa. Spoken, 3).

Participation in the SANCP after school mathematics clubs helped her to probably overcome her fear of mathematics as she expounds that: “I really appreciate their help, because even now sometimes when I’m struggling with maths I just think of the fun things we did, then you know (now) use them to mix fun and maths and don’t make everything like it’s tough, yah those years it was fun” (Lindelwa. Spoken, 6). She further reflects that, together with her fellow learners, they thought back to the activities that they learnt in the mathematics club and used some of the knowledge to overcome some of the challenges they faced in high school.

Although engagement and alignment in high school mathematics was tough, she believes in hard work to surmount the challenges. She explains that: “Yah, you know, and getting all those methods is not hard, it’s quite an easy thing, if you just concentrate” (Lindelwa. Spoken, 13). Furthermore, she continues her engagement with mathematics outside the school, when she is alone at her house, because “it really helps as sometimes in class you don’t really understand the teachers and then you get home you open the textbook and you see it the other way the teacher was telling you” (Lindelwa. Spoken, 16).

#### ***5.2.14.2 Lindelwa’s narrative and modes of belonging***

##### *Engagement*

Lindelwa recounts challenges in mathematics engagement in the past, where she explains that: “I was struggling with maths” (Lindelwa. Spoken, 1). She however transformed into a competent mathematics learner after joining the SANCP after school mathematics club.

In her chronicle of the after school mathematics club, she relates that, “when I joined the Maths club it made me realise that maths isn’t that hard and it is not about getting the right answer, but it was about understanding it, making everything fun and coming up with great new ideas on how to solve maths problems” (Lindelwa. Written, 3). She further explains that due to the tricks and strategies that she acquired in the after school mathematics club, she “was getting certificates for maths because I was one of the Top learners in Maths” (Lindelwa. Written, 6).

Lindelwa also expounds that, “what I loved about Maths clubs is that (the coordinators) gave us time and always used this words “Make Maths Fun” (Lindelwa. Written, 7), which brought enjoyment in mathematics engagement. Lindelwa further quips that, had the SANCP

mathematics clubs not been established, she “would be hating and failing maths” (Lindelwa. Written, 9).

Lindelwa explains that, on the transition to high school, she found that she was a learner who “was a bit scared, it was tough, because I think in the first term I got a level 5 in maths, it was tough, ...and I was new in high school..., I was scared, I was so scared (Lindelwa. Spoken, 7). The situation was compounded by the absence of the after school mathematics clubs “to help us and inspire us” (Lindelwa. Written, 11).

She further explains that “Grade 9 is still tough, it’s tough, but I’m trying, and I’m hoping to get things better” (Lindelwa. Spoken, 11), and “when I’m struggling with maths I just think of the fun things we did, then you know, use them to mix fun and maths and don’t make everything like it’s tough” (Lindelwa. Spoken, 6).

### *Alignment*

The SANCP after school mathematics clubs helped Lindelwa to comply with mathematical regulations as she discovered that mathematics, “isn’t that hard and it is not about getting the right answer, but it was about understanding it, making everything fun and coming up with great new ideas on how to solve maths problems” (Lindelwa. Written, 3). She also relates that her successful alignment with the mathematics practice resulted in her “getting certificates for maths because I was one of the Top learners in Maths” (Lindelwa. Written, 6).

### *Imagination*

Lindelwa reflects how in the past she “never liked maths it was the only subject I hated” (Lindelwa. Written, 2), but when she started engaging in the SANCP after school mathematics club she describes how she realised that mathematics is about “making everything fun and coming up with great new ideas on how to solve maths problems” (Lindelwa. Written, 3). Since that time, “I loved maths more and more, it became my favourite subject” (Lindelwa. Written, 5), and “in everything I did that has something to do with Maths I would think of (the club coordinators’) words” (Lindelwa. Written, 8).

She explains that: “I appreciate everything that Maths Clubs have done for me,” (Lindelwa. Written, 14) and argues that, had they not started the clubs, “I would be hating and failing maths” (Lindelwa. Written, 9). However she is now a competent participator in mathematics and continues to apply the “skills we developed from their Maths Clubs” (Lindelwa. Written, 12).

She reveals that in future, she will “do maths, because if I do maths there are many opportunities that I have and I think maths, maths is better than maths lit” (Lindelwa. Spoken, 12).

Lindelwa wishes for the continuation of the SANCP after school mathematics club activities in high school and that: “I just hope in the future we keep on coming together like this so we trust each other, that’s why maths becomes something nice, without difficulty” (Lindelwa. Spoken, 17).

### ***5.2.13.3 Summarising Lindelwa’s identity stories***

Lindelwa stories herself as a learner who struggled and hated mathematics in primary school. Her narrative about herself as a learner who struggled and hated mathematics was ameliorated when her FP teacher took her for some extra mathematical work after school.

She positions herself as a learner whose affinity for mathematics developed in the after school mathematics club and later mathematics became her favourite subject in school. She identifies herself as a learner who values the activities and strategies that they were taught in the after school mathematics club because some of them are still useful in high school.

Lindelwa imagines herself as a learner who identifies mathematics as tough, but she does not allow the difficulty to hinder her engagement in mathematics post the compulsory schooling stage.

## **5.3 SUMMARY**

In this chapter I described the coding rules of modes of belonging and further used them, together with some categories that I adopted from Solomon, to code all the spoken and written stories from the learners. I also contextualised the learners’ written and spoken stories as they traversed the learning communities from primary to high school, passing through the SANCP after school mathematics clubs. The contextualised stories were grounded in the Solomon categories of engagement in mathematics, stories about the nature of mathematics and stories about oneself as a maths learner, and in Wenger’s modes of belonging of engagement, alignment, and imagination.

In the contextualised learners’ stories, I described their preliminary narrative mathematical identities in primary school, SANCP after school mathematics clubs, high school and in their imagined future.

In the next chapter, I delve into the analysis and discussion of common MLIs and thematic outcomes from the learners' narratives. In the contextualised learners' stories, I described their preliminary narrative mathematical identities in primary school, SANCP after school mathematics clubs, high school and in their imagined future.

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## **CHAPTER 6**

### **ANALYSIS AND DISCUSSION**

#### **6.1 INTRODUCTION**

In this chapter I work to synthesise the analysis and discussion across the learners' narratives, beginning with the thematic outcomes which I situate in Solomon's (2009) category of learners' narratives about the nature of mathematics and Wenger's (1998) modes of belonging. I continue to analyse and discuss the thematic outcomes through the learners' descriptions of the nature of mathematics in the landscape of practice from Grade 1 through to high school. Furthermore, I connect learners' engagement or non-engagement and alignment or disalignment in relation to the modes of belonging. Lastly, I link the thematic outcomes to related local and international literature.

The list of common themes emerging from the learners' narratives illustrate align in relation to both Solomon's (2009) categories and Wenger's (1998) modes of belonging. I subsume the category of narratives about oneself as a mathematics learner (Solomon, 2009) into the imagination mode of belonging (Wenger, 1998) to explain themes that illuminate learners' reflections on their past, present and future identities as mathematics learners. Furthermore, I discuss the intertwined categories of narratives of engagement in mathematics (Solomon, 2009) and the engagement mode of belonging together (Wenger, 1998). The themes within this mode relate to learners' participation or non-participation in mathematical practices. The third group of narrative themes discussed here connect to the alignment mode of belonging (Wenger, 1998). These relate to learners' compliance or non-compliance with mathematical regulations in the landscapes of practice. There are, of course, some themes that fall into more than one of the categories described above, and this will be discussed where relevant.

#### **6.2 NARRATIVES OF IMAGINATION**

In this section I name and elaborate on the themes that emerge from the narratives. There are eight themes that strongly emerge across the learners' narratives of their imagination of themselves as mathematics learners. These are:

1. Learners' transformation from mathematical outsiders to identifying themselves as competent participators in mathematics.
2. Learners' narratives reflect a developing affinity for mathematics.



3. Learners imagine themselves as participating in mathematics-related occupations in the future.
4. Learners' narratives include moments of admitting to having considered 'quitting' Mathematics.
5. Learners expressed a fear and phobia of mathematics in the narratives.
6. Learners narrate how they embrace challenges in mathematics.
7. Most learners explain that they have chosen to continue studying Mathematics, rather than changing to Mathematical Literacy.
8. Learners narrate stories of failure in certain environments but tell of how this changed to experiences of success once learning in more educationally conducive environments.

Most learners (8/14) reflected on their transformational journey from mathematics outsiders to doers of mathematics (Martin, 2000) as represented by Funeka below:

I remember in Grade 1 in 2011 I was struggling with my maths. I couldn't find the difference between the signs of addition, subtraction, multiplication and division (Funeka. Written, 1). When I started in the intermediate phase I was struggling again because maths was not the same, we were working with big numbers and I was confused when it came to be using the column when multiplying (Funeka. Written, 5) ...I'll be doing maths, pure maths (Funeka. Spoken, 11) ... I think maths will help me because I want to be a doctor (Funeka. Spoken, 12).

Funeka's narrative of her mathematics journey shows a steady transformational trajectory from a learner who started the journey describing herself as a complete outsider, and yet she slowly develops an identity as a competent doer of mathematics.

Many learners (11/14) also tell narratives of being motivated to succeed in schoolwork and to develop love for mathematics through the various mathematics activities they engaged in as part of the different learning communities they passed through. Ayabonga exemplifies this in stating that: "I chose mathematics, pure maths because I saw from my past results that I was good at maths and that I love maths, it's like my passion" (Ayabonga. Spoken, 12). He emphasised: "I love maths, every time I get home I practise, now and again" (Ayabonga. Spoken, 5). Ayabonga, as for other participants, tells of an affinity for mathematics in primary school that has persisted into high school.

For some, the passion developed from their willingness to embrace challenges in the landscape of practice as normal and something not to be feared or avoided. For example, Cebisa expounds that: "I really love subjects that make you think, like I love being challenged, so yah, I think that's why I also love maths, because I love being challenged, I love to think outside the box" (Cebisa. Spoken, 33).

With regard to their imagined future participation in mathematics, most learners (10/14) recognised the gatekeeper effect in their imagined future and premised their engagement in mathematics on that, for example Ayabonga explains that: “I will work hard and do my best so that I can improve on my levels so that I can enter these institutions that I want to enter in life so that I can be a successful Marine Biologist or a Medical Doctor” (Ayabonga. Spoken, 22). Similarly, Nkosi reflects that: “In future I will have to do maths because I want to be a doctor and it is required, I have to do maths” (Nkosi. Spoken, 13).

Many learners in the study imagine using mathematics in life in general and in their imagined future careers. They reflect sentiments aligned to what Darragh (2013, p. 215) writes, which is that: “students who choose not to study Mathematics, or who fail to gain basic secondary Mathematics qualifications, have, as a result, more limited life and work choices.” Ayabonga and Funeka mention that they want to study medical sciences in future and are aware that one needs to have Mathematics to study such. Their mathematical engagement is predicated on their imagination of themselves in mathematics-related occupations, as represented by Ayabonga: “I also learned that if you want to get into Rhodes University you need like a higher level so that you can get into these institutions and my career requires a higher level of mathematics and physical sciences” (Ayabonga. Spoken, 21). Research shows that decreased engagement in mathematics can have a negative effect on learners’ future opportunities in relation to tertiary courses requiring high levels of mathematics (Darragh, 2013; Sullivan, Mousley & Zevenbergen, 2005). Some learners did not imagine using mathematics post high school and therefore chose to engage in mathematics through the subject Mathematical Literacy. Aphiwe explains: “I don’t think that I will use maths, because in the future I am thinking of being a social worker” (Aphiwe. Spoken, 7).

One learner considered quitting participation in Mathematics because of difficulties and failure to understand the concepts. Zimkhitha reflects on the difficult episodes that she came across in her mathematics practice as represented in the following example: “I chose to give up and quit school if they were to teach me Maths” (Zimkhitha. Spoken, 4).

Fear and a phobia of mathematics was a theme in the narratives of a few learners (3/14). They narrated how the discourse about the difficulty of mathematics within their school landscape of practice culminated in them developing an aversion for the subject, as exemplified in the following quotation: “In Grade 1 when I started doing Maths, I hated it because I was always told that maths is hard, so I had that mindset” (Nkosi. Written, 1). The fear of mathematics in

some of the learners was embedded in them before they engaged in the subject at all. Such mathematics discourses are validated the moment learners experience any challenges in the mathematical learning community. In other words, it can become a self-fulfilling prophecy, with generations of learners believing they are programmed not to be able to do mathematics. The learners who had managed this phobia foreground their future imagination of occupations that require mathematics to engage in the subject at all cost.

Some learners (10/14) described perceived mathematical challenges as essential to their learning, as the challenges stretched their thinking and allowed them to understand and succeed in life, for example: “I really enjoy Maths because I learn strategies and it stretches my brain and makes me able to tackle problems” (Lulu. Written, 33). In addition, Lindelwa showed preparedness to embrace challenges in the excerpt: “This year yeah, Grade 9 is still tough it’s tough but I’m trying, and I’m hoping to get things better” (Lindelwa. Spoken, 11). When learners imagine that their mathematical aptitude can increase by tackling challenging problems, “they orient toward doing just that, displaying an emphasis on learning, effort, and persistence in the face of obstacles” (Dweck, 2008, p. 4).

Many learners (11/14) realised the importance of mathematics in their lives and chose to continue with the subject Mathematics, rather than changing to Mathematical Literacy. This is captured in the following quotation: “It was then that I decided to carry on doing Mathematics in Grade 10 and for the rest of my life, because Maths is the only subject that I mostly love” (Ayabonga. Written, 13).

Given that research shows that a positive learning environment is “associated with and predictive of success” (Cohen, 2006, p.218) in mathematics, educators have a responsibility to create such positive learning environments. Sullivan and McDonough (2007) claim that a learning environment that promotes learner engagement with learning mathematics requires prior knowledge, a Curriculum that is relevant to the learners’ lives, interesting classroom tasks, and pedagogies and assessment regimes that match learners’ expectations. Four learners in this study expressed dissatisfaction with some learning environments in their mathematical journeys, as represented by Akhona that:

Well, when I was first introduced in maths in Grade 1, I liked it but I sometimes couldn’t understand the formulas I was given but as I moved from S. Msholozzi Primary to Mountview Primary, my maths teacher made me understand and she explained to me when I got lost and then that’s when I first realised that I really liked maths, love it (Akhona. Spoken, 1).

Positive learning environments, with relevant and adequate resources, are essential to the learning of mathematics. Learners reflected on how they missed the positive learning environment that they enjoyed in the SANCP after school mathematics clubs, for example: “I wish we have the same club even here in high school and carry on with the helping club” (Esihle. Spoken story).

Ayabonga: “I also learned that if you want to get into Rhodes University you need like a higher level so that you can get into these institutions and my career requires a higher level of mathematics and physical sciences” (Ayabonga. Spoken, 21). Research shows that decreased engagement in mathematics can have a negative effect on learners’ future opportunities in relation to tertiary courses requiring high levels of mathematics (Darragh, 2013; Sullivan, Mousley & Zevenbergen, 2005). Some learners did not imagine using mathematics post high school and therefore chose to engage in mathematics through the subject Mathematical Literacy. Aphiwe explains: “I don’t think that I will use maths, because in the future I am thinking of being a social worker” (Aphiwe. Spoken, 7).

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### **6.3 NARRATIVES ABOUT ENGAGEMENT IN MATHEMATICS**

The analysis of the data reveals eight themes that strongly emerge across the learners’ narratives of their engagement in mathematics. These are: Narratives of mathematics as being easy in Foundation Phase but increasing in difficulty in high school.

1. Narratives of mathematics as being easy in Foundation Phase, but increasing in difficulty in high school.
2. Learners' tell narratives of themselves as having moved from being mathematical outsiders to competent participants in mathematics.
3. Learners include in their narratives the choice they made between becoming a learner of Mathematics or becoming a learner of Mathematical Literacy.
4. The dislike of teacher-centred teaching was expressed in several narratives.
5. Learners include episodes in their narratives when people influenced their mathematical learning from outside of the classroom. In their narratives these people are significant presences in their mathematical journeys.
6. Learners include the after school mathematics club and express that they valued and appreciated these clubs and their membership in them.
7. There are learners who describe themselves as fearful of mathematics.
8. There are learners who describe how they embrace challenges in mathematics.

All the learners (14/14) consistently described mathematics as easy and even fun when in the Foundation Phase and as getting more difficult as they progressed to high school, as captured in the following quotations: All the learners (14/14) consistently described mathematics as easy and even fun when in the Foundation Phase and as getting more difficult as they progressed to high school, as captured in the following quotations:

I would just simply and easily get an answer by using my fingers to add and subtract from the given sums (Atha. Written, 3).

In intermediate phase (Grade 4-6) some of the equations and the standard became harder (Anathi. Written, 4).

I was really overwhelmed with the amount of difficulty as compared to primary (Cebisa. Written, 10).

The progression from easy to difficult to hard is evident in most of the narratives. According to Attard (2013, p. 569), many learners attribute “anxiety or dislike of mathematics to their experiences during the school years.” Some learners, as represented by Anathi, develop the ‘anxiety and dislike’ in the Intermediate Phase and their narrative reflects that by the time they reach high school they are learners who are already disaligned from mathematics, with some even expressing hatred for it. The phenomenon is not unique to this study, but Attard (2013, p. 570) reiterates that, in Australia, “there is acknowledgement of the decrease in engagement with mathematics during the middle years.”

All the learners (14/14) narrate a specific shared transformation in their mathematics engagement. They share that mathematics started with calculations that were easy to understand in the Foundation Phase. It is possible that primary mathematics was easier to understand if the teaching pedagogy was mainly child-centred and involved a lot of play with manipulatives. Research has shown that in the FP, learners appeared to display “preference for

tasks that require active learning, elements of choice, challenge, and the option of self-directed activities” (Attard, 2013, p. 575). However, mathematics evolved and became difficult as they traversed the mathematical landscapes of practice leading to high school. Anathi and Cebisa explain: “In grade 1, everything was easy, everything came to me easy (Anathi. Written, 2) ... In the Foundation Phase maths was so easy, it didn’t need much thinking” (Anathi. Written, 3), and Cebisa writes that: “I was really overwhelmed with the amount of difficulty as compared to primary” (Cebisa. Written, 10). Several learners highlight the increase in the amount of work and also the increased difficulty of mathematics as they transitioned to high school. This is in line with findings by Martin, Way, Bobis and Anderson (2015, p.200) that “[t]he transition from elementary into secondary school has been identified as a point where engagement in mathematics can decline somewhat markedly.”

Some learners (8/14) narrate a slightly different trajectory through past, present and forward into their future mathematics participation. Nkosi explains: “In Grade 1 when I started doing Maths I hated it because I was always told that maths is hard so I had that mindset” (Nkosi. Written, 1). He later developed his enterprise in mathematics to narrate himself as a competent learner, as indicated by the quotation that: “I practiced maths harder than ever until I got to a point where I was so good in Maths that my previous school sent me around the town and province doing maths competitions” (Nkosi. Written, 9). In the words of Lave and Wenger (1991), Nkosi started as a legitimate peripheral participator, that is, a novice in the learning communities who practices hard along the mathematics journey and ends up as a full participator in the landscape of practice.

Three learners chose to pursue Mathematical Literacy in Grade 10. The reasons for their choices are represented by this quotation: “I struggled when it came to solving problems like  $x$  so I decided when I’m in high school I would do Mathematical Literacy because it is easy for me to understand” (Aphiwe. Written, 6). Often learners regard Mathematical Literacy as an easier subject when compared to Mathematics. Its emphasis is to develop learners’ ability and confidence to think numerically and spatially in order to interpret and critically analyse everyday situations and to solve problems logically (DoE, 2003). It also aims to develop “positive mathematical learner identities” (Graven & Buytenhuys, 2011, p.2), hence it is a fundamental subject in the Curriculum.

Most learners (8/14) expressed that if you do not understand mathematical concepts, you need to seek out more knowledgeable people to assist “in negotiating the difficult boundaries”

(Fenton-O'Creevy, Brigham, Jones & Smith, 2015, p.57). Learners identified and acknowledged external assistance from significant individuals in their lives, who expressed care and provided support and encouragement as they traversed the mathematical landscapes of practice. Khethiwe narrates:

When I arrived at Mtambo High School, I was getting new to maths of high school because some of them I had never come across them and then I got help from my father because he loves maths and he is able to do it, so even our Principal offered that he would do afternoon classes of maths for Grade 8 so I attended it so that's how I got help in maths" (Khethiwe. Spoken, 4).

What she expresses is representative of other learners who include in their narratives that they embraced help from more knowledgeable people outside of the classroom. The conviction that these learners have, that if you do not understand a mathematical concept, you need to ask people around you who have knowledge to assist, would help other learners to reduce frustration, confusion and anxiety that is associated with the practice of mathematics. A few learners (3/14) expressed their dislike of teacher-centred teaching where the teachers are mainly concerned about completing the Curriculum rather than focusing on the learning process. Whereas in learner-centred contexts, "teaching mathematics is based on dialogue between teacher and pupils, so that teachers better understand the pupils' thinking and pupils can gain access to the teachers' mathematical knowledge" (Askew et al., 1997, p. 32).

The following excerpts are representative of the learners' narratives of themselves in teacher centred classrooms:

In grade 8 maths was starting to be more difficult for me because I'm a slow learner and my teacher did not want to always explain to me (Akhona. Written, 13).

...maths isn't like an easy subject you have to practice and all, so it isn't nice when a teacher just like fast forwards through the things and you just there, because you still have to practice at home and you can't practice if you don't understand what you were taught in class (Lulu. Spoken, 13).

In the narratives the importance of learner-centred teaching is linked to narratives about self, for example: 'I'm a slow learner' or narratives about mathematics, for example: 'Maths isn't like an easy subject.'

South African research has shown that, although the Mathematics Curriculum discourse foregrounds learner engagement in the classroom, teacher-led instructional methods are still the first choice (Umugiraneza, Bansilal & North, 2017). However, such practices promote Curriculum coverage at the expense of meeting the specific needs of learners (Graven, 2016). Teachers in the largely overcrowded 'traditional classroom' usually teach to complete the



Curriculum, hence it becomes difficult to develop teacher-learner relationships and difficult to develop more individualised and learner-centric instruction (Chingos, 2013).

All the learners narrate the importance of the after school mathematics clubs in their engagement in their mathematics journey. The following two excerpts from Esihle and Cebisa are representative of value and appreciation of the SANCP clubs by the learners:

I loved the maths club because it was making us clever because we had maths tricks that we used while doing an activity (Esihle. Written, 7).

Maths club had really set a good foundation for me and that's when I realised that I have a love for numbers (Cebisa. Written, 7).

This “good foundation” could have been what spurred Cebisa, and the other ten learners in the group, to identify themselves as competent to remain studying Mathematics, and to even imagine a future anchored in a mathematically-related profession. This aligns with literature that argues that the benefits of after school tutoring programs include increased learner achievement, a higher self-esteem, more and freer participation in class, and an increase in completion of homework assignments (Baker et al., 2006).

Eleven out of the fourteen learners participating in this study (78%) had chosen to continue doing Mathematics rather than changing their subject choice to Mathematical Literacy. This is largely different from the national percentage. Only 28% of Grade 12 learners writing their final examinations in November 2020 wrote Mathematics (McKane, 2020). The learners in this study tell of challenges experienced through their trajectory from the past (primary school), through to the present (high school) and nonetheless chose to remain learners who study Mathematics. For some, the choice to continue with Mathematics was because of the assistance they knew they would get from their peers:

“I met people who also love maths and that I loved because we helped each other because maths starting from grade 9 started being super difficult and we stayed together and worked as a team and we were able to pass Math and my love and passion for maths never ended so I chose to do Math in grade 10” (Nkosi. Written, 10).

Research reveals that learners largely continue doing Mathematics in the Further Education and Training phase (Grades 10 - 12) when they find it enjoyable, valuable, and important for success in school and for future career aspirations (Mohammadpour, 2012). Most of the participants in this study narrated identities as learners facing difficulties in mathematical alignment, but they also documented resilience through the difficult episodes and were prepared to soldier on regardless of the challenges. Ayabonga writes: “In grade 9 maths was like upgraded to another level because it seemed difficult but I kept going. It was then that I

decided to carry on doing Mathematics in grade 10 and for the rest of my life, because maths is the only subject that I mostly love” (Ayabonga. Written, 12 - 13).

The participating learners all described difficulties they encountered in their mathematics engagement as challenges that ‘stretched their brain’ and made them understand and succeed in their schoolwork. The following excerpt represents one of the learners’ thinking about embracing challenges:

And then I saw that maths is kind of hard but really challenging but fun at the same time. So, I like it because I like challenges and stuff. So, when I went on with maths in Grade 5, Grade 6 I did pretty well and then when I got to high school it got a bit tough and challenging. But I still choose maths in each and every subject I do (Akhona. Spoken, 7).

The quote shows that she was very resilient in her mathematics engagement in the landscape of practice. This positive mathematical learner identity coheres well with the SANCP discourse promoted in the after school mathematics clubs.

## **6.5 NARRATIVES ON ALIGNMENT**

Three themes emerged across learners’ narratives about their alignment with mathematics practices in their landscapes of practice:

1. learners describe mathematics as easy in the Foundation Phase, but increasingly challenging as they approached their present grade;
2. some learners describe a phobia of mathematics; and
3. others mention a dislike of certain teacher pedagogical practices.

All the learners narrate a successful alignment with mathematics practice in FP as represented by Cebisa: “Maths then was extremely easy, and it fascinated me so much (well it still does)” (Cebisa. Written, 3). They do, however, mention that mathematics alignment became difficult as they transitioned to higher grades especially in high school where the “[f]irst few weeks in grade 8 Maths, I was really overwhelmed with the amount of difficulty as compared to primary” (Cebisa. Written, 10). Disalignment in mathematics usually led to disengagement, where learners start to perceive mathematical challenges as insurmountable. This may lead to an amplification of perceptions that mathematics is too difficult and very confusing to learn, and the risk is that learners may quickly lose their interests and motivation to learn the content.

Fear of mathematics can result from learners’ inability to align with mathematics practices. A smaller number of learners (3/14) reveal that their fear of mathematics developed from societal discourse that the subject was hard; for example, Nkosi commenced school with a representative view that: “In Grade 1 when I started doing Maths, I hated it because I was

always told that maths is hard, so I had that mindset” (Nkosi. Written, 1). However, Nkosi and another learner later became competent mathematics learners as explained in (6.2.1.5).

In the endeavour to teach with assessment in mind, teachers in the traditional classrooms often use a teacher-centred approach to shift learners into memorising concepts for assessment without addressing the individual learner’s need to comprehend the mathematics they are doing. A few learners (3/14) expressed a strong dislike of teacher-centred teaching where learning is concentrated on listening to the teacher and trying to reproduce the teacher’s methods of working out mathematical problems. This method usually does not cater for individual pacing of learners. In such lessons, the teacher usually does not take time to further explain concepts when learners do not understand, as illuminated in this excerpt from Akhona’s narrative: “In grade 8 maths was starting to be more difficult for me because I’m a slow learner and my teacher did not want to always explain to me” (Akhona. Written, 13). Since alignment is concerned with compliance with various rules and regulations in the landscape of practice, failure to align may result in learners having limited engagement opportunities.

## 6.6 NARRATIVES ABOUT THE NATURE OF MATHEMATICS

The table below captures all 14 of the learners’ narratives on the nature of mathematics. It presents the parts of each written and spoken story that provide a narrative about the nature of mathematics. The row underneath Aphiwe’s narrative captures the key descriptors in the excerpts that learners used to describe the nature of mathematics in primary and high school. The full table is available as Appendix S.

Table 6.1 Aphiwe’s narrative and key words of the nature of mathematics in Primary versus High school

| Learners | Written narratives describing of the nature of mathematics                                                                                                                                                                                                                                                             | Spoken narratives describing of the nature of mathematics                                                                                                                                                                                                                                                                                                                                            |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Aphiwe   | <p>I remember doing mathematics at Grade 1, it was very enjoyable and exciting to do. (Written, 1)</p> <p>Maths could be challenging. At the Intermediate phase it started to become hard for me. (Written, 3-4)</p> <p>...I would do Mathematical Literacy because it is easy for me to understand. (Written, 7).</p> | <p>From Grade 1, maths was very fun and easy to solve because I was getting used to school and stuff, so I enjoyed maths from Grade 1, and when the years were passing, so Grade 2 was fun and I really enjoyed maths.</p> <p>Even Grade 3, there was starting to be a little bit of difficulty. (Spoken, 1-2)</p> <p>...then from Grade 8 I dropped in maths from Grade 8 because it was really</p> |

|                                                                                                           |                                                |                                                  |
|-----------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------------|
|                                                                                                           | Sometimes it could be confusing. (Written, 9). | difficult ...maths is challenging. (Spoken, 4-5) |
| <b>Primary mathematics</b> (enjoyable, exciting, fun, fun, challenging, a little bit of difficulty, hard) |                                                |                                                  |
| <b>High school mathematics</b> (confusing, really difficult, challenging)                                 |                                                |                                                  |

In my reading of the participants' written and spoken stories, it is apparent that they all describe 'the nature of mathematics' differently. I group the learners' descriptors of the nature of mathematics into two distinct categories, namely positive and negative. I treat positive descriptors as all words and phrases that describe mathematics as simple and easy to do in primary and secondary. I also use them to indicate when learners imagine successful uses of mathematics in future. The negative descriptors are words and phrases that indicate that learners describe the nature of mathematics as difficult and causing unpleasant experiences to learners as they engage and align with the subject. The decision to divide the text into positive and negative could be contentious, but I choose to do so here as it provides a useful broad framing of what emerged through these narratives. There are of course words that are *more* negative than others (e.g. "not as exciting" vs "challenging") and words that are relatively more positive than others (e.g. "easy" vs "MIND BLOWING").

Table 6.2 presents a list of these words and phrases used by the learners to describe the nature of mathematics (see Table 6.1), grouped according to whether they are either positively or negatively oriented, and according to whether they are made in reference to primary school or high school. For the words and phrases that appear more than once in Table 6.1, the number of instances of the use of that particular articulation is provided. For example, the specific word *easy* appears nine times across all narrative excerpts.

Most learners (13/14) describe the nature of mathematics as both positive and negative, often changing depending on the phase of schooling, though there is one learner who consistently describes the nature of mathematics negatively. A positive orientation in primary school does not necessarily imply that at a different point in their trajectory their orientation will similarly be positive.

Understanding the participants' narratives about the nature of mathematics allows an understanding and appreciation of the learners' engagement in mathematical practices in the landscapes of practice.

### 6.6.1 Positive orientations in narrating the nature of mathematics

Many learners (9/14) use the word easy to describe the nature of mathematics. For example, Anathi writes that, “[i]n grade 1, everything was easy, everything came to me easy” (Anathi. Written, 2). She repeats the same description of mathematics in her spoken story six months later that, “... I can say from Grade 1, it was like easy...” (Anathi. Spoken, 1), and she did not have any challenges. Cebisa and Sisipho shared Anathi’s description of mathematics in primary school. They narrate that it “...was extremely easy and it fascinated me so much (well it still does)” (Cebisa. Written, 3), and that, “at that time maths was fun and easy to do” (Sisipho written, 2). Although Zimkhitha was fairly noncommittal in her initial description of the nature of mathematics in FP when she describes it as “...kind of easy,” she later states that “it was so easy because (of what) I knew from maths club, so they usually helped me a lot” (Zimkhitha. Spoken, 5).

Lulu and Sisipho include narration on the nature of mathematics and Mathematical Literacy in their high school mathematical landscape. Lulu reflects that mathematics “...in grade 9 for me was very easy and enjoyable” (Lulu. Written, 25), while Sisipho, who had chosen to study Mathematical Literacy post the compulsory schooling stage in Grade 10, also reflects that the “[f]irst lessons for maths lit were great and I found it easy and fun” (Sisipho. Written, 6).

The nine learners presented above went to three different primary schools in the same town. Their convergence on the theme that mathematics was easy in FP might point to the assumption that as learners start school, they are usually eager to engage in any subject without having yet had the opportunity to adopt a fear of mathematics. The participants agree that they were learners who found the content that they were taught at FP to be extremely easy to understand and they did not need to solve complex problems. This might be linked to the participatory pedagogy and the concrete manipulatives that are often used in the FP classroom. According to Martin, Lukong and Reaves (2007, p.2), “working with concrete materials helps to enable learners to deconstruct complicated concepts to the level of their understanding and improves performance on mathematical tasks.”

As these learners proceeded through their school mathematical landscapes of practice, the after school mathematics clubs appear in the narratives as a landscape of practice that further helped to keep mathematical engagement manageable at primary school.

Two learners narrate that mathematics was also easy in high school, though in different contexts. While Lulu describes Mathematics in Grade 10 as easy, Sisipho describes

Mathematical Literacy as easy for her. Sisipho did not let her choice to do Mathematical Literacy affect her description of the nature of mathematics in high school.

Seven learners, among the fourteen participants, describe the nature of mathematics as fun in their narratives. Ayabonga writes: “At first math was so fun...” (Ayabonga, Written, 3), and he continues that it “...is actually a fun subject to do” (Ayabonga. Written, 11). Later in the narrative, he reiterates that he “didn’t see any difficulty in maths, Grade 4, Grade 5, it was like fun...” (Ayabonga. Spoken, 5) and that “...maths was quite fun and it was easy...” (Ayabonga. Spoken, 1). He concludes his written story by writing that, “in my life maths has been a fun and a challenging subject and also it is my friend” (Ayabonga. Written, 14). In addition, Esihle describes mathematics as fun in both the written and spoken stories. She relates that “...maths was fun and extremely easy” (Esihle. Written, 2), and again in her spoken story she comments that, “...from Grade 1 maths was fun” (Esihle. Spoken, 1). Akhona, Sisipho, Aphiwe, Lulu, and Khethiwe all make similar references. Only seven learners explicitly describe the nature of mathematics as fun at school, however, all mentioned enjoyment of the mathematical activities done in the clubs.

The other positive descriptors that were used by learners to describe the nature of mathematics are: manageable, ok, fine, nice, mind-blowing, straightforward and fascinating.

Lulu describes mathematics as “...quite manageable...” (Lulu. Written, 13) in primary school. The positive description of the nature of mathematics continued in high school where she describes mathematics as “...MIND BLOWING” (Emphasis original) (Lulu. Written, 26), and “very interesting” (Lulu. Written, 28). In addition, she narrates that in Grade 10, “maths is ok, but then there’s a big shift from Grades 1, 2, 3, 4 to now” (Lulu. Spoken, 16).

Cebisa describes mathematics as “straight forward” (Cebisa. Spoken, 2) in the FP and a “bit tricky” (Cebisa. Spoken, 10) in Grade 4, but generally “it was fine” (Cebisa. Spoken, 10). In high school, “Grade 8 maths was interesting” for her (Cebisa, Spoken 21).

Cebisa and Lulu narrate themselves as learners for whom mathematics was largely manageable, although their journey was not without its flaws as they recognised that the subject could be tricky at times. This is most likely expected in any journey that covers such a long period of time and which passes through different learning communities where mathematics could present difficult episodes to the learners. In the next section I describe the negative descriptions of the nature of mathematics.

### 6.6.2 Negative orientations in narrating the nature of mathematics

There are aspects of the learners' narration of the nature of mathematics that reflect a relatively more negative orientation at moments in their mathematics trajectory. The words hard, difficult, challenging, confusing and tough appear most prominently in these excerpts.

On the surface, the descriptors hard and difficult seem synonymous, but I use the Collins English Dictionary (Breslin, 2011) to distinguish the two descriptors as used by the participants. I interpret hard as referring to mathematics as very difficult and as requiring a lot of activity and effort to do (Breslin, 2011). On the other hand, I interpret difficult as meaning something that is not easy to do or understand or deal with. There is a subtle difference in the intensity of the two, with hard being more severe than difficult.

Many learners (9/14) describe mathematics as hard in primary school. Their narratives reveal that the extent of this 'hardness' intensifies as they move forward in their trajectory from FP to IP. The following excerpts are representative of their descriptions of the increase in 'hardness':

"In Grade 4, the maths started to be hard because we were no longer using the bottle lids to count ... " (Funeka. Spoken, 4).

"And then in Grade 6...it was a bit harder because the things they taught us at maths club didn't help me well, because my teacher had her own way of explaining and I wanted to get her way and not the maths club way ...so Grade 7 wasn't easy" (Zimkhitha. Spoken, 6).

Funeka narrates that the withdrawal of concrete manipulatives in the IP and the introduction of more abstraction, negatively impacted on her "computational fluency" (Berry, Thunder & McClain, 2011, p.15) and confidence in her own mathematical practice.

Zimkhitha's quote above presents a different narrative about what led to the increase in 'hardness' of mathematics for her as she moved from Grade 6 to Grade 7. She explains that the practices, artefacts and repertoires that were useful in the SANCP after school mathematics clubs were rejected in the classroom. This shows the tension that may result from different learning communities that learners belong to. The traditional pedagogy in the classroom clashes with the more liberal and problem-solving centred approach in the SANCP run clubs. In fact, the SANCP sought to 'disrupt' the traditional teaching practices that research shows are primarily practised in South Africa (Graven, 2011).

Half of the learners in the study described themselves as learners who found mathematics to be difficult in the Intermediate Phase and high school. In the IP, the difficulty of the mathematics for many coincided with the introduction of algebra, as explained by Ayabonga: "Then Grades

6 and 7 ah hey, that was the year we got to solve x and stuff, so it was quite difficult for me because I was learning new things, so I didn't like quite adjust" (Ayabonga. Spoken, 6). Most learners said that algebra was difficult and it affected their mathematics results. Their sentiments cohere with global trends where learners' difficulties with algebra are well-documented and indeed many learners' negative attitudes to mathematics are also associated with algebra (Mullis, Martin, Gonzalez, & Chrostowski, 2004).

All the learners in the study told narratives of themselves as learners who found mathematics to be difficult in high school. Nkosi writes that, "maths starting from grade 9 started being super difficult" (Nkosi. Written, 10). The difficulty may have emanated from a reluctance to let go of some mathematical practices that learners worked with in primary school that were no longer useful in high school, as captured in this narrative: "Now it is a bit difficult with the different (sic), you get more information on what you already know but then it's like I can't let go of what I already know first and then it's hard to adapt to the new things you are learning in Grade 10" (Anathi. Spoken, 8).

Less than half of the learners (6/14) describe the nature of mathematics as challenging as they traversed the landscape of practice from primary to high school. The use of the term challenging would suggest that learners experience difficulties that did not severely affect their engagement and alignment in mathematics practice. The difficulties in this context were surmountable in the end as illuminated in the words of Cebisa that, "maths was a bit manageable but when I got to Grade 6 that's when maths started being a little bit challenging" (Cebisa. Spoken, 9). But I battled my way through Grade 6 and 7 maths and then I got to high school and that's when maths took a real turn" (Cebisa. Spoken, 9).

Learners in this study are consistent in their views that challenges are surmountable in high school as represented in the following statement, "sometimes Maths could be challenging but I would stay focused and find a way to get through..." (Aphiwe. Written, 3).

Half of the learners describe the nature of mathematics as confusing while others view it as tough. Aphiwe and Zimkhitha use the descriptor 'confusing' to describe the nature of mathematics. Both Aphiwe and Zimkhitha are learners who chose to pursue Mathematical Literacy. Aphiwe writes: "Sometimes it could be confusing, but I taught myself to ask for help if it gets hard or confuses me" (Aphiwe. Written, 8). Their identification of Mathematics as confusing led them to choose Mathematical Literacy but did not affect their positive mathematics identity as they continued to enjoy 'mathematics' as explained by Aphiwe: "I



really enjoy Mathematical Literacy and I think I've made a great decision for myself" (Aphiwe. Written, 7).

The statement by Akhona that "when I got to high school it got a bit tough but I still choose maths in each and every subject I do" (Akhona. Spoken, 6-7) shows the resilient nature of learners in this study. Most did not let their identification of the nature of mathematics dissuade them from their engagement in the learning communities that they passed through from primary to high school.

It is interesting and important to note that, while many learners described the nature of mathematics as hard, difficult, challenging, confusing and tough, they maintained an affinity for the subject. Given the prominence of the after school clubs in most of their narratives, it is fair to speculate that this affinity for the subject may be traced back to their participation in the SANCP after school clubs, where learner resilience in the face of challenging mathematics tasks (Martin et al. 2015) was revered. The activities in the SANCP after school mathematics clubs revolved around the nature of mathematics and how learners could tackle various concepts in a manner that did not alienate them from the subject but rather promoted enjoyment and understanding of mathematics.

## **6.7 CONNECTING MATHEMATICAL LEARNER IDENTITIES TO ENGAGEMENT AND ALIGNMENT**

In this section, I specify and name the Mathematical Learner Identities present across the narratives. I first provide two figures presenting all identities, and then provide a summary table linked to extracts from the learners' written and spoken stories that align with these identities. I group similar MLIs and discuss their significance in the learners' engagement and alignment with mathematics as they traversed landscapes of mathematical practices on their school journeys.

The identifiable positive MLIs are summarised in the figure on the next page.



Figure 6.1 Positively oriented MLIs

In contrast, the more negatively oriented mathematical learner identities appear in Figure 6.2.



Figure 6.2 Negatively oriented MLIs

Table 6.2 presents selected extracts from Aphiwe’s story that captures a particular identifiable MLI. Each learner’s narrative presents a number of identities that shift across time, from the past, through the present and into their imagined futures, and thus a number of quotes are provided and a number of identities are shown to be present. Each corresponding mode of belonging is shown by one of the following letters: A-alignment; E-engagement; and I-imagination. Appendix T gives the information provided in Table 6.2 for all learners.

Table 6.2 Connecting MLIs and engagement and alignment (Aphiwe)

| Learners          | Articulated mathematical identities in the narratives                                       | Mathematical learner identities                                |
|-------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| <b>Aphiwe. 10</b> | ‘...I’m a hardworking learner.’ (Written, 5)                                                | A hardworking mathematics learner (+ve) E                      |
|                   | ‘...I really enjoy Mathematical Literacy...’ (Written, 7)                                   | A learner who enjoys M.L (+ve) I E                             |
|                   | ‘...I enjoyed maths from Grade 1...’ (Spoken, 1)<br>‘...I really enjoyed maths’ (Spoken, 1) | A learner who enjoys mathematics in primary (+ve) IE           |
|                   | ‘...I dropped in maths from Grade 8 because it was really difficult’ (Spoken, 4)            | A learner who struggles with high school mathematics (-ve) I E |

### **6.7.1 Learners' positive mathematics learner identities**

As indicated in the figures 6.1 and 6.2 as well as table in 6.2, I group MLIs into two categories: positive and negative mathematics identities. My analysis and discussion of MLIs is grounded in Wenger's (1998) three modes of belonging: engagement, alignment, and imagination. In this section I highlight learners' positive MLIs through selecting particularly strong examples of these to generate claims that contribute to answering my research questions.

#### ***6.7.1.1 Engagement as a mode of belonging***

In relation to the engagement mode, I sought participants' reflections and descriptions of their participation in mathematical work and describe how they experienced success or challenges that would either limit or enhance their participation in mathematical activities in the landscape of practice. I structure this discussion by considering one MLI at a time.

Some learners' (8/14) mathematical narratives reveal their increased engagement and alignment with mathematics in spaces beyond the formal classrooms, most notably the after school mathematics clubs.

Ayabonga provides a good example of this. His affinity for mathematics saw him working extra hard in the subject. He went beyond the formal school structures to gain more knowledge of the subject as illuminated in the excerpt:

“I also got previous papers for mathematics for November last year, so that I can work on the equations and see if I understand it and I also go to extra classes at school and also have a mathematics app on my phone that helps me to improve my results” (Ayabonga. Spoken, 17).

Ayabonga's imagination of what he needed to study post high school could have pushed him into engaging further in mathematics. His dream to pursue medicine or marine biology, fields that require mathematical proficiency, likely prompted him to seek various avenues of assistance.

Nkosi was similarly determined to increase his strength in the subject. When 'everyone' was contemplating changing to Mathematical Literacy, he chose to be the only of his friends to remain studying the subject Mathematics.

Research shows how small group instruction and workstations for learners with similar needs is an effective and workable solution (Benders & Craft, 2016; Taylor-Cox, 2013) to assisting learners in mathematics. Aligned to this were the SANCP clubs in which club facilitators worked “with learners in smaller groups focusing on specific learner needs informed by [their]

competence level and learning disposition” (Graven, 2015, p.3). This approach provides the opportunity for more tailored, individualized instruction, which may help to motivate as well as instruct learners (Jacob & Jacob, 2018).

Drawing on Graven (2015) and Jacob and Jacob (2018), I surmise that learners whose positive MLIs are aligned with what was promoted in the after school clubs gained strength in mathematics from the individualised educational attention they received in the clubs. For example, the following excerpt explicitly states how the learner valued the SANCP after school mathematics club:

“What I loved about Maths clubs is that [the club facilitators] gave us time and always used this word: “Make Maths Fun” [...] I really appreciate everything that [the club coordinators] did for me, because [if] they did not start the clubs I would be hating and failing maths” (Lindelwa. Written, 7&9).

“But still trying, trying to work hard and learn fast because the skills we developed from their Maths Clubs. But we still need and want the Maths clubs to start again if that’s possible. But still I appreciate everything that Maths Clubs have done for me” (Lindelwa. Written, 12-14).

Similarly, Esihle wrote that she “loved the maths club” (Esihle. Written, 7) and Akhona explained that, “[t]he clubs were very enjoyable, and there were fun games we played” (Akhona. Written, 8). Although the SANCP after school clubs are not run in high school, their influence on the learners’ ways of being mathematics learners is clearly discernible in their narratives.

#### ***6.7.1.2 Alignment as a mode of belonging***

In working with the alignment mode, I looked for participants’ reflections and descriptions of how they complied with mathematical regulations and/or submitted to external authority in their mathematical landscape of practice. The submission to authority in this instance is not necessarily passive but “a two-way process of coordinating enterprises, perspectives, interpretations, and contexts so that action has the effects we expect” (Oppland-Cordel & Martin, 2014, p. 21). I select prominent MLIs and highlight the important findings within those.

##### *Learners who excel at Mathematics*

Nine learners exhibited success-oriented narratives in their references to engagement in mathematics. Alignment signifies successful engagement in the landscape of practice. Some learners were awarded certificates for their hard work and perseverance in particular, as well as for their mathematical competence. These celebrated learners’ alignment to mathematics practice. Five learners recount narratives about how their alignment in mathematics was

rewarded with certificates of competence in different learning communities. The following excerpts are representative of the learners who were rewarded for their perseverance and hard work in mathematics:

Because in Grade 3 we were selected to do the maths club, as I was one of the learners and then I got a certificate which proven that I was the top student who achieved in maths (Anathi. Spoken, 2).

... all the years that I have been attending the club I was getting certificates for maths because I was one of the top learners in Maths (Lindelwa. Written, 6).

Receiving rewards for hard work at any stage in life is critical. It boosts the recipient's self-esteem and spurs them into multiplying their work rate. In the learner narratives one reads of how these certificates boosted learners who had low self-esteem and who doubted their aptitude in mathematics. For Anathi, the certificate was proof that she was the 'top student' and she carried this mathematical learner identity into high school and chose to pursue Mathematics rather than Mathematical Literacy.

Similarly, Akhona, Lisa and Lindelwa chose to pursue Mathematics in Grade 10. Although Zimkhitha chose to enrol in Mathematical Literacy, it is important to mention that she also narrates an enjoyment of the new subject and continues to use the ethos and principles acquired from the after school mathematics clubs in primary school. She reveals her alignment to Mathematical Literacy in stating that: "I'll be good in maths lit, because now I understand the things of maths lit, not pure maths things, I'm good in things of maths lit" (Zimkhitha. Written, 8). Zimkhitha still identifies herself as a doer of mathematics.

Further alignment to mathematics learning communities helped Sisipho, Cebisa and Ayabonga to excel in their mathematics practice. These learners' narratives tell us that their respective journeys were at times difficult and at times enjoyable.

Some of the participants narrate that their mathematics learner identities, as learners who excelled in mathematics, were challenged at times. Using the journey metaphor, the landscape of practice that the learners travelled did not present an even terrain from the start to where they were when they wrote their stories and participated in the interactive interviews; there were highs and lows, sharp curves and bridges to be crossed.

#### *Learners who are resilient*

I draw on Hutaurok and Priatna (2017), and Johnson-Wilder, Lee, Brindley and Garton (2015) who define resilience as the ability to deal with difficult situations that may affect learners'

mathematics negatively. The adverse situations that can arise when learners are faced with difficulties could potentially cause them to give up in the mathematics learning process.

A few participants (3/14) in the study provided narratives that indicate significant levels of resilience. Ayabonga's resilience saw him taking more responsibility for his learning after he had failed mathematics at some points in his mathematical journey, as reflected in the quotation that:

... in Grade 9 maths was like upgraded to another level because it seemed difficult but I kept going thou (sic) I fail term 1, I tried my best to have a good come back and luckily learned other new ways to find an answer e.g. new formulas (Ayabonga. Written, 12).

For Cebisa and Ayabonga, falling down at a moment in their journey was not a problem. Their narrative reveals an implicit understanding that the mathematics journey was not flat terrain, and that rather, it meandered through different high peaks and low valleys. Their resilience saw them falling down as well as standing up to continue on their mathematics journey. The resilience was probably a result of Ayabonga's imagined future where he dreamt of becoming a medical doctor, which may have assisted him in applying that resilience:

So I will work hard and do my best so that I can improve on my levels so that I can enter these institutions that I want to enter in life so that I can be a successful Marine Biologist or a Medical Doctor (Ayabonga. Spoken, 22).

Helping learners to develop mathematical resilience enables them to adapt positively to the difficulties presented by mathematics and to be in a position to consider continuing to develop their mathematics (Johnstone-Wilder & Lee, 2010). Aphiwe boldly states that: "I'm a hard-working learner." Such positive narrated Mathematics Learner Identities point to learners' confidence in their ability to generate new and meaningful understandings of mathematics.

Learners who are competent in mathematics

Three participants specified times of understanding mathematics in their narratives, as represented by the following quotations:

I understood what was going on in class and I was very engaged (Lulu. Written, 17).

And then in Grade 10 in term one I did really good because I chose pure maths and then I was doing good and I understood the teacher that was teaching me (Anathi. Spoken, 7).

The concept of understanding is a pertinent principle associated with the attainment of educational goals. Learners with a conceptual understanding of mathematics are able to retain more knowledge about the subject than just isolated facts and methods. According to Kilpatrick et al. (2001, p. 118), learners "understand why a mathematical idea is important and the kinds

of contexts in which it is useful. They have organised their knowledge into a coherent whole, which enables them to learn new ideas by connecting those ideas to what they already know.”

In line with Kilpatrick and colleagues, Lulu’s explanation that she “understood what was going on in class” and that she “was very engaged” (Lulu. Written, 17) represents some of the learners’ sentiments in terms of their mathematical understanding. When learners fully understand what they are being taught, engagement and alignment also increase. Teachers’ teaching methods are influential in learners’ engagement and alignment with mathematical practices, as explained by Anathi that: “I understood the teacher that was teaching me” (Anathi. Spoken, 7).

### ***6.7.1.3 Imagination as a mode of belonging***

In foregrounding imagination in the learner narratives, I present narrative excerpts in which the participants reflect on and describe their imagined past, present and future as a mathematics learner. I have included participants’ expressions of their emotions towards engaging in mathematics and their views around their understanding of mathematical meanings (Oppland-Cordel & Martin, 2014).

#### *Learners who love mathematics*

Most participants (11/14) narrated their love for Mathematics. This love for mathematics did not develop at the same time, but at different stages in the mathematics trajectory which saw the participants passing through diverse learning communities in the landscape of practice. This coheres with Bishop’s (2012, p.43) observation that, “students in the same class, engaged in the same activity, abiding by the same classroom norms and participant structures can and do enact very different mathematics identities.”

Ayabonga. articulates that he discovered that he had “love for mathematics” (Ayabonga. Written, 9) by the end of primary education. His love for mathematics was spurred on upon realising that the algebraic equations he feared the most were not as difficult as he had imagined.

Cebisa reflects: “I realized I loved maths in Grade 3” (Cebisa. Spoken, 4). The development of her affinity for mathematics coincided with the commencement of the after school mathematics club. She further explains that the club coordinator “really made my love for maths increase...” (Cebisa. Spoken, 6). Similarly, Nkosi states that: “I love maths and what motivated me to study [was] the maths club” (Nkosi. Spoken, 3). These two learners’ positive mathematics identities



from the foundation phase may be the reason that their narratives include descriptions of largely successful engagement in mathematics in high school.

Positive MLIs would motivate learners in their engagement with mathematics. This coheres with the assertion that participation in a landscape of practice gives participants the framework of an experience of identity - in this case a positive MLI (Wenger-Trayner, 2015).

Akhona ascribes her love for mathematics to her FP teacher: “[M]y maths teacher made me understand and she explained to me when I got lost” (Akhona. Spoken, 1). Seemingly the human and material resources that learners are exposed to assist in overcoming obstacles in the landscape of practice. Wenger-Trayner and Wenger-Trayner (2015, p.17) describe boundaries as “places of potential misunderstanding and confusion arising from different regimes of competence, commitments, values, repertoires, and perspectives.”

Lastly, Lindelwa explains that: “I loved maths more and more, it became my favourite subject” (Lindelwa. Written, 5). Similarly, she attributed her love for mathematics to external resources in the landscape of practice as captured in the following quotation:

...when I joined the Maths club it made me realise that maths isn’t that hard and it is not about getting the right answer, but it was about understanding it, making everything fun and coming up with great new ideas on how to solve maths problems (Lindelwa. Written, 3).

Lindelwa seems to adopt the principle of ‘embracing of errors as learning opportunities’ from the after school mathematics clubs. As explained earlier (chapter 2) one of the foci of the SANCP clubs was on “developing positive and confident learning dispositions” (Graven 2012, p. 58), hence they were encouraged to embrace making mistakes. Graven (2012) continues that in the clubs they:

...emphasise that there is no shame in not knowing, as we are all learners, and it is because there is always much that we do not know that we come together to learn. Thus, emphasising the Socratic philosophy, that it is better to know what you do not know than to think you know, we encourage learners to share and articulate what they do not know (p. 58).

The concept of ‘making mathematics fun’ from the after school mathematics clubs seems to have stuck with Aphiwe and Sisipho as they narrate a continued enjoyment of mathematics despite their choice to study Mathematical Literacy in Grade 10. They explain:

As for now I really enjoy Mathematical Literacy and I think I’ve made a great decision for myself (Aphiwe. Written, 7).

I am happy with Maths [Literacy] and I enjoy it and I am willing to learn more about maths (Sisipho. Written, 11).

Although evidence suggests that learners who struggle to perform well in mathematics are usually guided towards taking Mathematical Literacy (Graven & Buytenhuys, 2011), the learners in this study reveal in their narratives a “positive and confident learning disposition” (Graven 2012, p. 58), and continue to recognise themselves as doers of mathematics.

#### *Learners who persevere when faced with mathematical challenges*

According to Wenger (1998, p.195), “imagination can yield a sense of affinity, and thus an identity of participation, but it can also result in a reaction of dissociation and a consequent identity of non-participation.” The first part of Wenger’s assertion coheres with some learners’ determination to participate in mathematics regardless of the challenges. Four learners reveal that their imagination is focused on success and they are prepared to overcome obstacles in their landscape of practice.

Akhona shows her determination to succeed in mathematics despite the challenges she encounters along the trajectory. Her determination to succeed is captured in the following quotation: “Whenever I got something wrong in a sum, I would get frustrated because I always wanted to get everything right” (Akhona. Written, 4). Her perseverance in mathematics is further illuminated in the assertion that: “I still choose maths in each and every subject I do” (Akhona. Spoken, 7). Akhona imagines mathematics as follows: “I saw that maths is kind of hard, but really challenging but fun at the same time” (Akhona. Spoken, 4).

What learners imagine about the nature of mathematics influences their participation in the mathematical landscape of practice. Cebisa and Nkosi narrated positive identities of themselves in the landscape of mathematics practice in their description of mathematics. They imagined mathematics as a challenging subject and themselves as learners who thrive under challenges. For example Cebisa shared her imagination of mathematics in the landscape of practice in the following excerpt from her spoken story: “I really love subjects that make you think, like I love being challenged, so yah, I think that’s why I also love maths, because I love being challenged, I love to think outside the box” (Cebisa. Spoken, 33).

#### *Learners who are hard working*

Three learners narrated themselves as tireless and industrious learners in the landscape of mathematics. This excerpt from Aphiwe’s narrative provides an example: “At the Intermediate phase it started to become hard for me and I used to find help to those around me or former

students at my school. Because, I'm a hard-working learner. I would take the challenge and try to work it out on my own" (Aphiwe. Written, 4-5).

Aphiwe narrates an imagination that he is "a hardworking learner". This is, according to Wenger (1998, p. 176), "an important component of our experience of the world and our sense of place in it. It can make a big difference for our experience of identity and the potential for learning inherent in our activities." Cebisa articulates that she loves "having to think and sweat" and eventually celebrates when she gets the answers correctly. As a hardworking learner, Ayabonga articulates that: "I will never fail to overcome something that cannot talk."

### *Learners who imagine themselves doing mathematics after secondary school*

There were 3 learners who imagine themselves pursuing the study of mathematics after high school. Ayabonga and Nkosi imagine themselves as doctors, hence the need to continue engagement in mathematics as it is a compulsory entry requirement into their careers of choice: "In future I will have to do maths because I want to be a doctor and it is required, I have to do maths" (Nkosi. Spoken, 13).

For learners who narrate that they intend to pursue careers in STEM related fields, this positive MLI is present. This is as exemplified by Ayabonga:

So I will work hard and do my best so that I can improve on my levels so that I can enter these institutions that I want to enter in life so that I can be a successful Marine Biologist or a medical doctor (Ayabonga. Spoken, 22).

Learners' imagination of their future participation in mathematics plays a significant role in their present engagement in the subject. Learners who intend to pursue careers that require mathematics are likely to persevere in mathematics practice rather than learners who do not wish to continue with mathematics related occupations. Fenton-O'Creevy et al. (2015) describe such learners who wish to continue with a given practice or enterprise as 'sojourners'. They explain that sojourners do not aim to assimilate within a landscape of mathematics practice but aim "at accommodation to the practices of the community and its regime of competence in order to function effectively within and beyond the community" (p.45). Learners with an identity of wanting to pursue mathematics will likely work hard and resiliently to understand mathematics concepts. They will endure and overcome the obstacles that they will inevitably come across in their mathematics trajectory.

## 6.7.2 Learners' negative mathematics identities

In this section I highlight learners' negative MLIs through selecting particularly strong examples of these to generate claims that contribute to answering my research questions.

### 6.7.2.1 Engagement as a mode of belonging

To investigate the engagement mode of belonging I extract from the learners' narratives their explanations of obstacles and challenges that prevented their engagement in mathematics.

#### *Learners who struggle with mathematics*

Nine learners narrate successful engagement in mathematics in their past, but Sisipho started to struggle in Grade 7 where she writes that “years went by, things started to change a bit, in Grade 7 the maths started to get harder” (Sisipho. Written, 4). Obstacles developed at the moment of the introduction of algebra, which she identifies as difficult for her in high school: “I find it hard to solve questions that included solving for x” (Sisipho. Written, 5). Her narrative about her struggle in breaking through the obstacles in high school seems to reveal a decreasing self-confidence in relation to mathematics. Sisipho later decided to choose to study Mathematical Literacy.

Unlike Sisipho, whose struggle started in high school, Zimkhitha narrates a struggle in mathematics engagement and alignment from the FP. She explains that, in Grade 1: “I was not good in maths, so I was struggling a lot” (Zimkhitha. Spoken, 1). She does later explain that after joining the after school club, she managed to overcome obstacles and challenges in her landscape of practice. Her struggles appear again in her narrative in relation to high school mathematics and, as a result, she chose to study Mathematical Literacy.

Some of the learners used the words difficult, overwhelmed, battled, struggled and confused to describe the misunderstanding and confusion arising from different regimes of competence (Wenger-Trayner & Wenger-Trayner 2015). The following excerpts characterise how the participants struggled with mathematical engagement in the landscape of practice:

I battled my way through grade 6 and 7 maths and then I got to high school and that's when maths took a real turn. First few weeks in grade 8 Maths, I was really overwhelmed with the amount of difficulty as compared to primary (Cebisa. Written, 9-10).

When I started in the intermediate phase I was struggling again because maths was not the same we were working with big numbers and I was confused when it comes to using the column when multiplying (Funeka. Written, 5).

Cebisa, Anathi, Funeka, and Lindelwa narrate a battle and struggle in their journey of mathematical practice. Cebisa's battles were most pronounced at the end of primary school. Lisa narrates that her struggles in mathematics emanated from her difficulties in distinguishing between some of the mathematical operational symbols: "At first, I was confused by Maths. I couldn't tell the difference between addition and subtraction...I would get low marks and I would feel bad about myself" (Lisa. Written, 2-3).

Khethiwe's challenges in mathematics were multiple. She narrates her struggles in understanding mathematical concepts as emanating from her age: "I was struggling to do maths because I was 9 years" (Khethiwe. Written, 1). The usual age of a Grade 1 learner is 7. She writes that, "I didn't understand how to count the maths [...] I couldn't understand the difference between the signs of multiplication, subtraction and adding" (Khethiwe. Written, 3&5). She narrates that the situation was compounded by the introduction of algebra in Grade 7. Several learners in this study complained that algebra was difficult for them.

Khethiwe further narrates that in high school she faced challenges in comprehending what the teacher was teaching: "In grade 9 I struggled a lot, I won't lie ☹ ☹ because I couldn't hear the teacher when he was teaching" (Khethiwe. Written, 18). Lulu narrates a similar experience in high school:

[The maths teacher] was very fast and maths isn't like an easy subject you have to practice and all, so it isn't nice when a teacher, just like fast forwards through the things and you just there, because you still have to practice at home and you can't practice if you don't understand what you were taught in class (Lulu. Spoken, 13).

#### ***6.4.2.3 Imagination as a mode of belonging***

To explore the imagination mode of belonging I extract from the learners' narratives their more negatively oriented imaginings of themselves as mathematics learners.

##### *Learners who identify themselves as slow learners*

Three participants describe themselves as slow learners. It is not known exactly what they meant in this description, but according to literature, this would imply that these learners require special pedagogy that is altered and geared to their slower pace of learning (Borah, 2013; Lohman, 2011). It is possible that these learners were expressing that they took longer than other classmates to complete the tasks, but these excerpts from Akhona and Zimkhitha are clearer: "In grade 8 maths was starting to be more difficult for me because I'm a slow learner and my teacher did not want to always explain to me" (Akhona. Written, 13); "I wasn't a good

catcher when it comes to learning maths” (Zimkhitha. Spoken, 1). These highlight the importance of quality pedagogical practices. Describing oneself as a slow learner and not being a good ‘catcher’ of mathematics should not be confused with learners in need of special education, or reluctant learners who are non-cooperative (Painogoni, 2018). These learners and others who resemble them are capable of excelling in mathematics if the correct pedagogical practices are implemented. Borah (2013) concludes that so-called slow learners are not averse to learning, and have no limitations for learning, but in fact have their own psychology for learning, though the negative tone these learners apply in their narratives when explaining this alludes to their identifying themselves as having limitations for learning.

### *Learners who narrate themselves as finding mathematics difficult*

Research shows that there is widespread opinion among learners of mathematics that it is difficult, and that most learners opt out whenever possible (Brown, Brown & Bibby, 2008). In South Africa, learners have the option to continue to study Mathematics or to choose to pursue Mathematical Literacy from Grade 10 onwards. Both are the study of mathematics, although with different objectives and outcomes.

The difficulty in mathematics, as explained by Akhter and Akhter (2018) revolves around the nature of mathematics which imposes high conceptual demands on learners. They continue that mathematical procedures appear to be abstract and unrelated to life. The abstract nature of mathematics places high demands on working memory capacity (Reid, 2009).

Three learners in this study similarly conceptualise mathematics as difficult and causing them distress: “I had times where I didn’t fully understand some sections and that made me feel very miserable and not want to have Maths and not want Maths periods to happen and cause me to panic” (Lulu. Written, 30). It is possible that learners with such MLIs could opt out of Mathematics to avoid hardship.

Ayabonga explains why he perceives mathematics as difficult in high school in the following excerpt:

It was then that I thought that maths was going to be hard because we were solving not only numbers but letters like (x) [...] Then in Grade 9 maths was like upgraded to another level because it seemed difficult but I kept going thou (sic) I fail term 1, I tried my best to have a good come back and luckily learned other new ways to find an answer e.g. new formulas (Ayabonga. Written, 8 & 12).

Ayabonga’s narrative shows that he is resilient and that he tried several ways to overcome obstacles and become a confident doer of mathematics, including with considerable

“ownership of meaning” (Wenger, 1998, p.200) to use in further engagement and alignment with the subject. Ayabonga’s MLI that mathematics was difficult did not stop him from working hard, an ethos that aligns with what would have been promoted in the after school mathematics club.

In contrast, Aphiwe opted to do Mathematical Literacy, despite the assistance that she was receiving from the teachers and colleagues in the landscape of practice. She recounts that:

Yeoh, it was beating me, but because of my classmates and the teacher they tried to help me, but then from Grade 8 I dropped in maths from Grade 8 because it was really difficult (Aphiwe. Spoken, 4).

I struggled when it came to solving problems like (x) so I decided when I’m in High School I would do Mathematical Literacy because it is easy for me to understand (Aphiwe. Written, 6).

It is fundamental to note that the learners who selected Mathematical Literacy did not abandon mathematics, they enrolled in a differently formulated mathematics curriculum which was designed to equip learners with functional Mathematical Literacy.

### *Learners who fear mathematics*

Two learners in the study narrated their fear of mathematics in high school. Some learners develop fear of mathematics due to many reasons, which include the perceptions that mathematics is a difficult subject and that they lack the ability to comprehend mathematical concepts and tasks and fear failing examinations (Mazana, Montero & Casmir, 2019).

The fear of failure and ‘the lack of ability to comprehend mathematical concepts’ stood out as the narrated causes of aversion in Mathematics in the case of Esihle and Lindelwa. The latter’s quotation echoes the former’s sentiments that: “First year I came I was a bit scared, it was tough, because I think in the first term I got a level 5 [60-69%] in Maths, it was tough, yeoh, and I was new in high school..., I was scared I was so scared” (Lindelwa. Spoken, 7).

It is possible that the narrated identity of being a learner who fears mathematics was related to the new learning community that Lindelwa had just joined. Failure to comprehend the ‘new’ mathematics of high school was exacerbated by the low marks that she attained in the first term compared to primary school. The fear of continued failure to overcome obstacles might lead to mathematics phobia which can be defined as a feeling of anxiety that stops learners from efficiently tackling mathematical problems (Kunwar, 2020). Researchers observed that even relatively ‘good’ maths learners who had a lower sense of confidence, experienced fear and anxiety, with slight variations in the conditions in the landscapes of practice (Abbasi,

Samadzadeh & Shahbazzadegan, 2013). The MLI of fear of mathematics narrated by Esihle and Lindelwa did not last long enough to affect their affinity for mathematics, as both decided to continue doing Mathematics.

## **6.8 SUMMARY**

In this chapter I discussed the thematic outcomes and identifiable mathematical learner identities that emanated from an analysis across all 14 narratives. The discussion was framed by Wenger's three modes of belonging strands into which I had subsumed Solomon's categories. The themes were varied and were separated according to whether they reflected relatively positive or relatively negative mathematical learner identities. All the learners valued the mathematics practices in the after school clubs and explained that they sought assistance outside the classroom from parents, siblings and friends. As reflected in this chapter, these clubs, however, appear in slightly different ways in the narrative mathematical learner identities. I also expounded on learners' descriptions of the nature of mathematics. In the next chapter I will answer the research questions and report the findings of the study and the conclusion.



## **CHAPTER 7**

### **CONCLUSION**

#### **7.1 INTRODUCTION**

This chapter presents the findings of the study and answers its research questions. It opens with a short story where high school learners reflect on their mathematics trajectories from primary school to now. The reflections focus on the learners' mathematics identities of the past and present and allow them to imagine their future engagement in mathematical activities.

In the chapter I also state the limitations of the study methodology and mention the various possibilities for future research in learner mathematical identity. I further expound on how the study contributes to the academic field especially on the significance of learner mathematical identity in primary school through to high school.

#### **7.2 THE SHORT STORY**

Darragh and Radovic (2019), in their article "To Tia with love": Chilean mathematics teacher identities after professional development, use an innovative and creative presentation of their data by identifying shared stories in their interview data, and creating a fictionalised film synopsis. Similarly Sfard (2019) draws on the fifteen research papers presented in the ZDM special issue, Identity in Mathematical Education, to tell a single narrative in the form of an interview between the "Ideal Mathematics Education Researcher" (p.555) and a journalist.

Drawing on the approach taken by these researchers, I will represent the most prominently recurring themes from the fourteen narratives in this research through a short story, built around a fictional protagonist, Tinashe. The text covers three scenes that represent the main landscapes of practice that the learners traversed in their mathematics journeys. Through this exercise I seek to provide "a holistic view of the experiences" of the participants (Lutovac & Kaasila, 2018, p.512).

The five fictitious characters represent the MLIs of the 14 learners who participated in the study. Tinashe and Thembaletu started off hating mathematics, but after participating in the afterschool mathematics clubs, they transformed into resilient doers of mathematics and their stories resonate with from Lulu, Nkosi, Funeka, Khethiwe and Lisa. The second group of participants represented by Lebogang (Cebisa, Ayabonga, Lindelwa, Anathi, Akhona and Esihle) loved mathematics from when they started primary school. Their affinity increased

when they joined the afterschool mathematics clubs. They acknowledged and embraced the challenges in mathematics and later chose to continue doing mathematics post the compulsory stage and in their imagined future. Zaza and Luyanda represent participants (Aphiwe, Sisipho and Zimkhitha) who were aligned in mathematical activities and successfully engaged in primary school but perceived the subject as difficult in high school and chose Mathematical Literacy.

## **A Mathematics Journey: Mathematics or Mathematical Literacy**

*Tinashe stays huddled in her chair, gazing at her peers who have set off running, screaming with excitement, towards the staff car park of eRhini Primary School. They want to be the first there, to carry their teacher's two baskets full of their books back to the classroom. Most of the learners adore Mrs Ntaba for the way she teaches: the patience and passion with which she gives learners individual feedback on their work, and her encouragement for them to persevere and seek assistance when they face challenges in mathematics.*

*Tinashe, though, does not feel the same. She marvels at how Mrs Ntaba had caused her distress with all the difficult mathematics exercises that she knew Tinashe would NEVER understand. She grimaced as she remembered how the teacher ALWAYS tried to change her mindset that mathematics is difficult and very hard. All her life her friends and family had told her how mathematics had traumatized them in primary school.*

*Tinashe's solitude is abruptly disrupted as Mrs. Ntaba enters the classroom and wastes no time starting her routine demonstration of mathematics concepts on the chalkboard. She asks learners to work out more examples in groups, and later, individually. She moves around the groups, enthusiastically stopping at each group, observing, listening, asking and answering questions.*

*Tinashe is whispering to her friend about how she enjoyed the mathematics games under the big jacaranda tree the other day. Mrs. Ntaba overhears her, and asks which games learners enjoy the most. Suddenly all hands are raised as the children compete to list their favorite games. Mrs Ntaba reminds Tinashe and her peers about the afternoon session in her office that day.*

*Later that afternoon, Tinashe and her peers are walking to the backroom at the assembly hall where the after school mathematics club is held. The club coordinator's yellow van can be seen parked under the big jacaranda tree, so the learners walk briskly and chat amongst themselves.*

*Tinashe says to her friend Zaza, in an animated but hushed voice, "You know, I started enjoying Mathematics more when I joined this club. I mostly enjoy that our coordinator usually asks what is giving us problems in the classroom and then teaches us tricks and strategies to use to solve multiplication and division sums."*

*Zaza nods her head enthusiastically. “Yeah, it has improved my mathematics skills too! I use some of the tricks in the classroom and even help others when they are stuck in the classroom or when they are doing their homework. I enjoy the games a lot!”*

*The girls have reached the club room door, and just before going in, Tinashe whispers, “The games we play here are so interesting and they have helped me to improve my maths performance. My results are so much better, and I can now stand in front of the class and explain concepts if Mrs Ntaba asks me to...” Before she can say anything more, the club coordinator opens the door and the learners enthusiastically walk into the room.*

*As usual, the club coordinator has some pleasant surprises for the group. She explains that they are going to hold a Mathematics Relay, and asks the learners to work in pairs.*

*An excited hustle and bustle begins as the seven pairs of learners proceed through the different stations of the relay. The club coordinator has carefully selected activities which relate to the various concepts learners had asked for help with in the previous meeting, and they work together, chatting and helping each other. Tinashe and Zaza find that they are stuck on an activity, so they call the coordinator. “M’am, we’re stuck on station five! Please help us?” say the girls, but the coordinator cleverly does not offer direct solutions, instead helping the girls by probing and asking subtle questions. Zaza, Tinashe and the other learners don’t know this, but the way the coordinator is responding is designed to help them to develop the ability to make sense of the maths problems themselves, by working together. The club coordinators’ plan is to enable the learners to think independently and to develop both resilience and enjoyment of mathematical challenges.*

*When the bell rings, all the learners groan - they don’t want the club to be over yet! They reluctantly bid farewell to the club coordinator; they all wish the club could run longer and be run more than once a week.*

*It is a few years later, and Tinashe, Zaza and their friends are now at high school. It is breaktime, and they are sitting on a concrete bench overlooking the disused fishpond in the school grounds. They are discussing various issues, including the end of term assessment tests which they are currently writing. Tinashe heaves a big sigh. “Sometimes I miss our days at primary school, especially when we used to attend the after school mathematics club,” she says sadly. “The activities there used to motivate me a lot. I would even continue practicing mathematics at home, with the help of my parents and some of my neighbours.”*

*In unison, her friends chorus “Oh, that? Yes, yes!” Themba lethu, who attended a different primary school, speaks enthusiastically. “I also attended an after school mathematics club at my primary school, yeah it was so much fun and helpful, and in fact I still use some of the tricks and strategies here in high school.” The others nod. Themba lethu continues, “I used to regard myself as a lazy and slow learner in mathematics, but the games and quizzes we did in the club opened my mind and I embraced it. Now it is my favourite subject.”*

*Zaza throws her hands up in the air in exasperation. “Yeoh! For me, Mathematics in high school is no child’s play, guys. You see, I struggle a lot in algebra and the different equations. My dad tries to help but somehow the way he explains is different from the teachers who teach me and that confuses me even more. He has his own ways and the teachers use different methods and I don’t know who to follow.” She stops talking to take a deep breath.*

*Lebogang, who went to the same primary school as Themba lethu, crumples up his lunch packet, and stands up to throw it into the dustbin. While he is walking, he says, “Look, I totally agree with you that mathematics is hard but as for me, I will continue struggling with it until Grade 12. I was told that good degree programmes at university require a pass in Mathematics, so I will persevere.”*

*Tinashe interrupts him excitedly. “Lebo, you are very right there! I used to struggle a lot in primary, but I persevered and now I enjoy Mathematics and I will continue doing Mathematics because I want to be a Marine Biologist when I finish matric. I now love Mathematics more than I love you guys...” She shrugs her shoulders and grins, and the friends all burst out in laughter. Tinashe continues, saying, “You see, there are some careers in life that you can never train for if you don’t pass Mathematics at Grade 12. So, it is important to decide what you want to do in future first, before choosing between Mathematics and Maths Lit.”*

*“You are very right, Tinashe,” Zaza says, “but I honestly feel that I need a lot of help in Mathematics. The mathematics clubs must be introduced in high school!” This makes the group chuckle, but Zaza keeps speaking. “I am struggling to understand the mathematics teacher; ummmm, pure Mathematics is not for me, it is too difficult. I struggle with algebra, our quadratic equations.... what else?” She thinks for a moment, then takes a deep breath.*

*““ I have already decided that I will do Mathematical Literacy in Grade 10 because it will serve my needs in life and after school...My dream career is Social Work and I hear Mathematical Literacy is enough for me to study that at any university in South Africa. So, I*

*don't think I need Pure Mathematics, but yeah, it's really important to consider what one wants to study after Grade 12, and its mathematical requirements."*

*The fifth member of the group, Luyanda, has been listening quietly, but now he speaks for the first time. "Hey, Zaza, I chose Maths Lit last year and tell you what, I am really enjoying it. I honestly love doing Maths Lit and the teacher is also very good and so I think you are making a good choice...."*

*The sharp shrill ringing of the siren interrupts him - breaktime is over. Gathering their things, the friends rush to their different classrooms for their next lessons, but all are glad they had this discussion. All five are happy that they have thought about their choices now, and have made the correct decision for their futures.*

## 7.3 FINDINGS

In the short story A Mathematics Journey, we are brought into the world of Tinashe, Zaza, Lebo, Thembaletu, and Luyanda through a narrative that traverses the mathematical landscapes that each learner in this study has moved through: primary school classes, an after school mathematics club and high school classes. The story provides a rich narrative that provides more than each individual narrative could by including projected interactions between these characters. These fictional characters, and the narrative in which they appear, presents a synthesis of the dominant narrative identities in the learners who participated in this study. who are characters that represent the mathematics learner identities present in the participants' narratives. The story is a form of synthesis of the narrative MLIs of the learners who participated in this study.

In the discussion that follows I discuss the findings already presented in Chapters 5 and 6, this time connecting them to the Research Questions. The analytical framing provided by Wenger's (1998) modes of belonging structures this presentation. In Chapters 5 and 6 I drew particularly on Wenger's (1998) modes of belonging to frame the learners' narrative Mathematical Learner Identities with reference to engagement, alignment and imagination as modes of belonging. The study also drew on Solomon's (2009) strands of learner narratives about the nature of mathematics, narratives of themselves as mathematics learners and narratives of their engagement in mathematics. Lastly, these narrative mathematical identities, which were multiple and shifting for each learner, were categorised as either positively or negatively oriented. Next, I draw on learners' narrative MLIs and the key thematic outcomes from their narratives to answer the study's research questions.

### 7.3.1 Research Question 1

What are the MLIs of high school learners who participated in after school mathematics clubs in primary school?

#### *Engagement*

A strong feature of these narratives is the repetition across narratives that these learners engage in mathematics beyond the classroom. For many this extends even beyond the SANCP after school clubs to include forming peer groups and explicitly requesting intervention.

Drawing on Graven (2015) and Jacob and Jacob (2018), I ascribe (at least in part) learners' positive MLIs as being due to their participation in the after school clubs where they gained

strength in mathematics and learned resilience and perseverance: “But still I appreciate everything that Maths Clubs have done for me” (Lindelwa. Written, 14).

Positive MLIs strongly motivate learners in their engagement with mathematics in the landscape of practice. Wenger-Trayner and Wenger-Trayner (2015) do assert that participation in a landscape of practice (in this case the SANCP after school clubs) allows learners to develop an identity, in this case a positive MLI. Therefore, although the SANCP after school clubs are not offered in high school (as it is a primary school project), their influence on the learners’ narrative mathematics learner identities is discernible.

In partial response to this question, I list positive mathematical learner identities of engagement as drawn from the analysis of the narratives. Through the narratives of the participants, we are introduced to learners:

- who are engaged in mathematics beyond the classroom
- who seek assistance and enrichment in mathematics
- who take initiative to seek assistance
- who persevere in solving challenging mathematics problems
- who take responsibility for their learning
- who made thoughtful decisions about their subject choice
- who embody the ethos of the after school mathematics club
- who learned mathematical concepts in the clubs
- who are lovers of mathematics
- who enjoyed engaging in club activities
- who are motivated to learn and do mathematics

Although many learners narrate successful engagement in mathematics in their past (primary school), they write narratives of disengagement with the subject in the present. The excerpt from Sisipho’s narrative is representative of many: “years went by, things started to change a bit, in grade 7 the maths started to get harder” (Sisipho. Written, 4). For many, this disengagement developed around the introduction of algebra which she singled out as difficult for her in high school: “I find it hard to solve questions that included solving for x” (Sisipho. Written, 5). The struggle in overcoming the challenges that this new mathematics posed in high school led to negative identity narratives, for example, “I wasn’t a good catcher when it comes to learning maths” (Zimkhitha. Spoken, 1) and “I’m a slow learner” (Akhona. Written, 13).



Some of the learners used the descriptors difficult, overwhelmed, struggled, and confused to reflect the misunderstanding and confusion arising from different regimes of competence (Wenger-Trayner & Wenger-Trayner 2015) in mathematics learning. Zimkhitha, in particular, narrates a struggle in engaging with mathematics in the past where she wrote that, “I was not good in maths, so I was struggling a lot” (Zimkhitha. Written, 1). Although she later explains that, after joining the SANCP, she managed to overcome these challenges, her narrative again relates struggles in high school, leading to her decision to pursue Mathematical Literacy.

Interestingly, Cebisa, Anathi, Funeka, Khethiwe, Lisa and Lindelwa narrate that they struggled in mathematics but chose to continue studying Mathematics. They did not allow the difficulties they came across to hold back their potential to engage and align with Mathematics, a subject they all narrated a love and enjoyment of in their narratives.

Through the narratives of the participants, we are introduced to learners: who struggled with mathematics

- who disengage when the mathematics became more difficult (e.g. algebra)

- who are ‘slow’ to understand the concepts

- who are not good ‘catchers’ of mathematics

- who only enjoyed mathematics in primary school and at the clubs

### *Alignment*

Here I reflect on participants’ narratives of how they aligned to mathematics practices. Nine learners exhibited success-oriented experiences in their narratives about engagement in mathematics, revealing a clear alignment of their narrative identity with mathematics. Some learners’ alignment was rewarded with certificates of competence for distinctive results, while others exhibited positive shifts in their mathematical identities, which were also recognised by certificates for perseverance, progress and hard work. The latter were particularly emphasised in the clubs.

Although Zimkhitha chose to select Mathematical Literacy, it is worth mentioning that she noted that she enjoyed the new subject and continued in her narrated identity as being aligned to being a mathematics learner: “I’ll be good in maths lit, because now I understand the things of maths lit, not pure maths things, I’m good in things of maths lit” (Zimkhitha. Spoken story).

Several learners narrate that the mathematics landscape of practice presented both difficult and enjoyable episodes in their mathematics learning. Their narratives revealed that as they travelled through the various communities, they came across difficult episodes where

engagement in mathematics presented challenges that were difficult to break through. The narratives also revealed that there were moments when learners aligned successfully and were able to surmount the challenges and celebrate successful alignment in mathematics.

Using the journey metaphor, it is significant to note that the landscape of practice that the learners travelled did not present an even terrain from their start in Grade 1 to where they were when they wrote the stories and carried out the interactive interviews. Instead they expressed that there were highs and lows, sharp curves, and bridges to be crossed, all in pursuit of alignment with mathematics.

I draw on Hutaurok and Priatna (2017), and Johnson-Wilder, Lee, Brindley and Garton (2015) to define resilience as the ability to deal with difficult situations. A lack of resilience in mathematical practice significantly affects learners' alignment with mathematics participation. They continue that adverse situations may arise when learners are faced with difficulties that may make them give up in the mathematics learning process.

Some participants in the study exhibited significant levels of resilience in their narratives as represented in Ayabonga's written narrative. His resilience and alignment was evident when he took more responsibility for his alignment to his mathematics community after he had failed mathematics at some point:

... in Grade 9 maths was like upgraded to another level because it seemed difficult but I kept going thou (sic) I fail term 1, I tried my best to have a good come back and luckily learned other new ways to find an answer e.g. new formulas (Ayabonga. Written, 12).

It is probable that the SANCP focus of helping learners to develop mathematical resilience contributed to this narrative MLI of being a resilient learner (Johnstone-Wilder & Lee, 2010), aligned to mathematics as reflected by Akhona:

I tried my best to pass and so I did... Maths was a lot harder than before, but I taught myself to work hard and practice every day (Akhona. Written, 14).

Aligned to this, Aphiwe, stated emphatically: "I'm a hard-working learner" (Aphiwe. Written, 5).

Through the narratives of the participants, we are introduced to learners:

who are successful at mathematics

who are choosers of Mathematics

who are choosers of Mathematical Literacy

who find mathematics easy and difficult at different times

who overcome challenges

who are at times aligned and at times non-aligned to mathematics  
who are resilient  
who persevere when faced with adversity  
who are hard working learners

### *Imagination*

There were eight narrative MLIs discernible regarding the imagination mode of belonging and they are evenly distributed between positive and negative identities.

Learners' affinity for mathematics developed at different stages in the mathematics journey which saw them participating in diverse learning communities in the landscape of practice. Bishop (2012) explains that learners in the same classroom, engaged in the same activity, abiding by the same classroom norms and participant structures, can and do enact very different mathematics identities.

Significantly, most learners developed a love for mathematics in their narrated past (primary school), while others revealed that they discovered their love for mathematics in the narrative present (high school). For example, one of the learners explained that his love for mathematics was spurred upon realisation that the algebraic equations that he feared the most were not as difficult as he had imagined. Some ascribed their affinity for mathematics to their teachers or after school club facilitators at different stages in their mathematical journey. These positive narrative MLIs helped learners to maintain their imagination of themselves as doers of mathematics in their past, present and future. This reveals itself when considering that despite the fact that the clubs included learners who were representative of all ability levels (not only learners who excelled at mathematics), 79% chose to continue with Mathematics. This is a striking contrast to the national statistic that states only 28% of the learners who wrote their final school examinations in November 2020 wrote Mathematics.

The concept of 'making mathematics fun' from the after school mathematics clubs seems to have stuck with many learners, including some who chose to study Mathematical Literacy. According to Wenger (1998, p.195), "imagination can yield a sense of affinity, and thus an identity of participation". This assertion coheres with some learners' narrated determination to participate in mathematics regardless of the challenges they came across in their practice. Most (10/14) narrate that when their imagination is focused on success, they are prepared to endure and break through any mathematical challenges in their landscape of practice. What learners imagine about mathematics would determine their identity within the mathematical landscapes

of practice. The urge to surmount mathematics challenges in the landscape of practice comes from learners' imagination of the subject. For example, if learners have had challenges with mathematics in the past and imagine that Mathematics will not help them in the future, they may well disengage from the subject in the present.

Some learners in the study imagined mathematics as challenging and themselves as learners who thrive under challenges, hence they were prepared to endure any challenging episodes because of the positive MLI of endurance. Learners also imagined themselves as hardworking and this clearly pushed them into confronting challenges in the landscape of practice and seeking external assistance from more knowledgeable others around them when needed. For example, Aphiwe describes herself as tireless and industrious. This excerpt from her narrative reveals this aspect of her imagination about this image of herself in the past:

At the Intermediate phase it started to become hard for me and I used to find help to those around me or former learners at my school. Because, I'm a hard-working learner, I would take the challenge and try to work it out on my own (Aphiwe. Written, 4-5).

Her self-identification as 'a hardworking learner,' links to Wenger's (1998, p. 176) notion of imagination of oneself as "an important component of our experience of the world and our sense of place in it. It can make a big difference for our experience of identity and the potential for learning inherent in our activities." Aphiwe's imagination of herself as hardworking is critical in supporting her in confronting challenges and seeking assistance when needed.

Some learners even imagine pursuing mathematics-related studies in future. Ayabonga and Nkosi imagine themselves as doctors, hence the need to continue studying Mathematics as it is a prerequisite entry requirement into these careers. For example: "In future I will have to do maths because I want to be a doctor and it is required, I have to do maths" (Nkosi. Spoken, 13). Similarly, some learners intend to pursue other careers in STEM-related fields and hold positive narrative mathematical identities, as exemplified by Lindelwa in her explanation of her future ambitions in the quotation that:

I don't know maybe, I can say if we keep on seeing each other like this in this maths club, I think this thing is just a u know, I do it with hope/trust so that one day, like yah, maybe I'll be a scientist and then I'll get level 7s mostly, because I want to study at Rhodes, so you know I have to work hard (Lindelwa. Spoken, 14).

Learners' imagination of their future participation in mathematics is discernible in their narratives to play a significant role in their present engagement in the subject. Learners with an identity of wanting to pursue Mathematics are significantly motivated to succeed at

Mathematics in order to meet their future goals. They narrate themselves as being hard working and resilient mathematics learners.

Some participants narrate themselves as being lazy and slow learners. Lulu described herself in her narrative as sometimes 'lazy' to fully concentrate in Mathematics. She stated: "I get lazy at times and I feel like maths needs your full-on attention" (Lulu. Spoken, 20). Two other learners shared that they are "a slow learner (Akhona. Written, 13) and "not a good catcher when it comes to learning maths" (Zimkhitha. Written, 1). It is interesting to note that although Lulu and Akhona characterise themselves as 'lazy' and 'a slow learner' respectively, they went on to choose to continue studying Mathematics.

Some learners imagined mathematics as difficult and reported that it caused them stress, for example: "I had times where I didn't fully understand some sections and that made me feel very miserable and not want to have Maths and not want Maths periods to happen and cause me to panic" (Lulu. Written, 30). Three learners with such experiences chose not to study Mathematics to avoid enduring hardship. For example, "I struggled when it came to solving problems like  $(x)$  so I decided when I'm in High School I would do Mathematical Literacy because it is easy for me to understand" (Aphiwe. Written, 7).

Others, however, confronted the challenge: "I told myself that nothing, that I will never fail to overcome something that cannot talk, so I will try my best in Grade 11, I will keep on doing pure maths" (Ayabonga. Spoken, 19).

Research shows that even some competent learners develop fear of mathematics due to perceptions that Mathematics is a difficult subject, a lack of comprehension of mathematical concepts and tasks and a fear of failure (Mazana, Montero, Casmir, 2019). The fear of failure and the lack of understanding mathematical concepts stood out as the causes of aversion to mathematics for Lindelwa. She reveals that: "First year I came I was a bit scared, it was tough, because I think in the first term I got a level 5 in maths, it was tough, yeoh, and I was new in high school...I was scared, I was so scared" (Lindelwa. Spoken, 7).

This fear did not last long enough to affect her developing a love for mathematics as she decided to continue doing Mathematics, and does express a love for mathematics in her narrative. This coheres with research observation that even relatively good maths learners, due to lack of a proper mathematical sense of confidence, experience fear, and anxiety with slight variations in the conditions in the landscapes of practice (Abbasi, Samadzadeh & Shahbazzadegan, 2013).

There are learners in this study who narrate a hatred of some sections of Mathematics such as algebra and equations. For example: “At first I never liked maths it was the only subject I hated” (Lindelwa. Written, 2). Cebisa singled out two topics that she hated: “I absolutely hated algebra...I hated algebra, yes. Another topic I hated, I think we did probability in Grade 6 as well, I’m not sure” (Cebisa. Spoken, 13).

Through the narratives of the participants, we are introduced to learners:

- who have an affinity for mathematics
- who imagine themselves as doers of mathematics, even if doing Mathematical Literacy
- who imagine themselves as successful in Mathematics in their final examination
- who are determined to participate in Mathematics
- who understand mathematics to be challenging but imagine themselves as overcoming this
- who seek assistance in working towards realising their imagined success
- who imagine themselves using mathematics in the future
- who imagine themselves as pursuing careers that involve mathematics
- who imagine mathematics as difficult and this is a source of stress

### ***7.3.1.1 Consolidated response to Research Question 1***

Learners’ repeated narration of constant engagement in mathematical activities outside the school likely indicate positive MLIs borne of their participation in the afterschool mathematics clubs. The SANCP landscape of practice exposed learners to the importance of seeking assistance when they are faced with challenging sums and enjoyment of mathematics as a subject. However, some learners narrate episodes of disengagement at the beginning of high school where they mostly indicated their struggle to understand algebra and to cope with the increased amount of work.

Some learners narrate success-oriented engagement in mathematics, an indication of alignment to mathematical conceptions in their mathematics journey. The stories indicate more success in alignment mostly in primary than in high school, where they reveal episodes of disalignment caused by the more challenging concepts. The development of learners’ affinity for mathematics did not happen simultaneously regardless of the fact that they participated in almost identical landscapes of practice.

Interestingly, many learners explained that they loved mathematics more in primary than in high school. According to Wenger (1998), the positive imagination of mathematics yields a sense of affinity which in turn builds an identity of participation as revealed by most learners’ imagination of themselves as doers of mathematics who are prepared to work hard to overcome

the challenges and succeed in the subject. They actually imagine themselves pursuing careers that involve mathematics in future. However, there are some learners who imagine Mathematics as a source of stress, hence they decided to pursue Mathematical Literacy.

### **7.3.2 Research Sub-Question 1a:**

What are the key themes in learners' narratives of their current mathematical participation? This is explored extensively in Chapter 6, but here I present a summary that emphasises the main points.

#### *Themes about Engagement*

All the learners in the study described engagement in mathematics as easy in primary school but becoming difficult in high school. As mentioned earlier, this is significant as it corresponds with research which shows that in primary school, learners are exposed to “tasks that require active learning, elements of choice, challenge, and the option of self-directed activities” (Attard, 2013, p. 575), which they mostly enjoy. Learners highlighted that the increase in the amount of work and the shift from concrete to abstraction of mathematical concepts, as they transitioned to high school, affected their engagement. This agrees with Martin, Way, Bobis and Anderson's (2015, p.200) findings that: “The transition from elementary into secondary school has been identified as a point where engagement in mathematics can decline somewhat markedly.”

It is significant to note that some learners (8/14) transformed from at times being mathematical outsiders to active productive mathematics participators, as they travelled across landscapes from past (primary school) to present (high school). They revealed how the journey started with many challenges, but as the years went by, they became competent doers of mathematics through perseverance. They told stories of failure in uncomfortable mathematics environments but loving or enjoying it and succeeding at it in the conducive environments. For example, most learners mention the SANCP after school mathematics clubs as the space that helped them to become competent engagers, as exemplified by Akhona that when: “I moved from S. Msholozhi Primary to Mountview Primary, my maths teacher made me understand and she explained to me when I got lost and then that's when I first realised that I really liked maths, love it” (Akhona. Spoken, 1).

Eleven learners (78%) chose Mathematics in the FET stage. Their choice to pursue Mathematics was despite the challenges they all alluded to in both primary and high school. It

is important to note that most of the participants in this study narrated identities of having difficulties in mathematical engagement, but they also documented resilience through the difficult episodes and were prepared to soldier on regardless of the challenges. Interestingly, resilience was one of the ethos that underpinned the SANCP after school mathematics clubs. One can therefore argue that the learner mathematics identities that the learners exhibit may have been influenced by their participation in the after school maths club spaces in primary school.

Three learners struggled with Mathematics and decided to rather choose Mathematical Literacy. They regarded the subject as less difficult when compared to Mathematics. Mathematical Literacy aims to develop “positive mathematical learner identities” (Graven & Buytenhuys, 2011, p.2) and real-world mathematics competence, hence it is a fundamental subject in CAPS, and a legitimate form of mathematics.

Learners acknowledged external assistance from more knowledgeable others who expressed care and provided support and encouragement as they traversed the landscape of mathematics practice. It is critical to note that these learners understood that if you fail to comprehend some mathematics concepts, you need to seek assistance from more knowledgeable others who have the capacity and knowledge to assist, as this helps to reduce frustration, confusion and anxiety associated with mathematics practice.

Two learners disliked teacher-centred learning where the teachers are mainly concerned about completing the curriculum, hence they ignore learners who work slower than the teacher’s pace. Research shows that, although the South African Mathematics Curriculum foregrounds learner engagement in the classroom, teacher-led instructional methods were still the first choice for most teachers (Umugiraneza, Bansilal & North, 2017). Teachers in overcrowded ‘traditional classrooms’ teach to complete the required curriculum; hence it becomes unfathomable to develop teacher-learner relationships and more individualised and learner-centred instruction (Chingos, 2013, p. 413), which would cater for all learners but risk failing to complete teaching the required curriculum.

Every learner narrated the importance of the after school mathematics clubs as being influential in their engagement in the mathematics journey. Learners reflected on the solid foundation that they received from the varied mathematical activities that they participated in at the after school clubs. The good foundation and emphasis on growth mindsets supported



most of the learners in this study to pursue Mathematics from Grade 10 to 12, and even to imagine a future anchored in mathematically related professions.

### *Themes about alignment*

All the learners revealed narratives of successful alignment in Mathematics in primary school, but they narrated that as they transitioned to high school, they were overwhelmed with the difficulty and the quantity of work that they were supposed to do. The difficulties led to some disalignment in mathematics, which led to learner perceptions of mathematical challenges as insurmountable.

### *Themes about imagination*

Some learners imagine future engagement in lifelong mathematics learning. Ayabonga, Esihle, Khethiwe, Lisa, Funeka and Lindelwa narrate the importance of mathematics as a gatekeeper into some critical careers. Significantly, learners' choices to continue studying mathematics align with Darragh's (2013, p. 215) observation that, "students who choose not to study mathematics, or who fail to gain basic secondary mathematics qualifications, have, as a result, more limited life and work choices."

It is pertinent to note that many learners imagined mathematical challenges as essential as these 'stretched their brains' and permitted a greater depth of understanding to prepare them for success in life. The narratives reveal learners for whom hard work and resilience are important aspects for one to succeed.

Two learners narrated how the discourse about the difficultness of mathematics in their landscape of practice culminated in them developing fear of the subject. The fear of mathematics largely resulted in learners failing to align with the mathematics practice.

One learner considered quitting participation in mathematics because of the difficult episodes that she came across, and her failure to overcome some of the mathematics challenges in the landscape of practice. She further imagined that she could not endure the difficulties in the FET and chose to do Mathematical Literacy.

The policy makers in South Africa would be well-advised to take note of the benefit of setting solid mathematical foundations and positive mathematical learner identities by establishing and providing resources for afterschool mathematics clubs that are run by knowledgeable and respected members of the communities in the schools or community centres.

### 7.3.3 Research Sub-Question 1b:

How do learners' stories of their mathematics learning trajectories from their past participation and in relation to their imagined future participation feature in their present mathematics narrative mathematical identities?

Learners' narratives of their mathematics trajectories from their past participation in mathematics and their relation to their imagined future participation in lifelong mathematics learning largely feature in their present mathematics participation.

Learners narrate active participation in the SANCP after school mathematics clubs, where they engaged in various problem-solving activities and fluency games, which incorporated play and other exciting repertoire, that made their love for mathematics increase. Some learners reveal that they still use the strategies they learned in the past to solve mathematical tasks in the present. The following example is representative of some learners' perceptions of the importance of the strategies gained from the SANCP after school clubs, "the maths club really helped me because I got to know new strategies, I've learnt a lot and then since there, from Grade 4, I continued using the... the strategies they taught us, I followed them in order to get maths well" (Zimkhitha. Spoken, 4).

The influence of learners' imagined future in mathematics is seen in their narratives of their present participation. Their imagined future careers influence their present participation in high school mathematics. For example, learners who imagined themselves as doctors narrate positive mathematics learner identities as hard workers who are resilient and are prepared to seek external assistance when they do not understand concepts taught in the classroom, for example: "I also learnt that if you want if you want to get into Rhodes University you need like a higher level so that you can get into these institutions and my career requires a higher level of mathematics and physical sciences (Ayabonga. Spoken, 21). So I will work hard and do my best so that I can improve on my levels so that I can enter these institutions that I want to enter in life so that I can be a successful Marine Biologist or a Medical Doctor" (Ayabonga. Spoken, 22).

Interestingly, learners like Aphiwe shared that they imagined future careers that did not require pure mathematics but Mathematical Literacy, and this influenced their choice to pursue Mathematical Literacy instead of Mathematics. Aphiwe argues that: "I don't think that I will use maths, because in the future I am thinking of being a social worker" (Aphiwe. Spoken, 7).

### 7.3.4 Research Sub-Question 1c:

How does their participation in the after school clubs feature (if at all) in their mathematical identities?

A particularly striking finding is that the learners' MLIs are heavily influenced by the approach taken in the SANCP after school mathematics clubs. The clubs valued hard work and encouraged learners not to shy away from asking for assistance when in doubt. In line with this ethos, the learners demonstrated resilience and hard work in their narratives. In fact, the SANCP after school mathematics clubs seem to have taught learners the importance of knowing that which you do not know, and the importance of asking for help. Making mistakes was not equated with failure. In fact, mistakes were celebrated as important components of learning. This disposition is evident in all narrative mathematical learner identities

Literature on the SANCP mathematics clubs reveals that activities performed in the clubs are pertinent to the social, emotional, and physical development of learners (Graven, 2011). This is similar to global trends where the activities within out-of-school networks support the development of collaboration, discussion and teamwork that are conducive to deeper levels of understanding in mathematics (Briggs-Hale et al., 2006).

In the learner narratives, their participation in the SANCP after school mathematics clubs features strongly in their narrative mathematics learner identities, especially where they show resilience in mathematics activities. For example: "when I joined the Maths club it made me realise that maths isn't that hard and it is not about getting the right answer, but it was about understanding it, making everything fun and coming up with great new ideas on how to solve maths problems" (Lindelwa. Written, 3). The spirit of resilience in difficult episodes and endurance were some of the promoted values that learners were exposed to in the after school mathematics clubs. Some of the intended MLIs of the SANCP clubs include active and playful mathematical engagers, resilient problem solvers who embrace mistakes and take them as opportunities to learn, lovers of mathematics and confident mathematics learners who rise to challenges (see Chapter 2.4).

Some learners premise their positive narrative MLI on after school mathematics clubs, for example: "I really appreciate everything that [club facilitators] did for me, because [if] they did not start the clubs I would be hating and failing maths" (Lindelwa. Written 9). Furthermore, Esihle explains how the after school club features in her mathematics identity: "I loved the

maths club because we had maths tricks that we used while doing an activity” (Esihle. Spoken, 7).

Some of the learners’ mathematics identities cohere with the promoted identities in the after school mathematics clubs. In the clubs, learners worked in very small groups or individually in order to maximise their contribution to the activities being carried out. The optimal participation induces confidence where learners start to believe that they are capable of doing mathematics. This inevitably builds love of mathematics, for example, “[the club facilitator] made us play around with maths and I began to love maths even more” (Akhona. Written, 9).

Importantly, learners continued the spirit of teamwork that was promoted in the SANCP after school mathematics clubs as represented in the following excerpt: “I met people who also love maths and that I loved because we helped each other because maths starting from grade 9 started being super difficult and we stayed together and worked as a team and we were able to pass Maths” (Nkosi. Written, 10).

The policy makers in South Africa should consider extensive professional development drives that seek to disrupt the passive learning culture that promotes teacher-centred mathematics pedagogy, and step in to promote working with learners in such ways that build confident mathematical participators (Graven, 2011), with positive MLIs such as those evident in the participants in this study.

#### **7.4 LIMITATIONS OF THE STUDY**

The qualitative tools that I deployed to generate data in this study were chosen to explore the complex and evolving phenomenon of mathematical learner identity of a cohort of underprivileged high school learners who participated in the after school mathematics clubs in their primary school. Theorising identities as narratives meant that asking learners to write their stories and to further narrate them would reveal their mathematics identities.

The initial plan was to gather two more stories that would have given me a more comprehensive picture of the stories about the learners’ mathematics journeys from primary to high school from two extra sources, namely their SANCP after school mathematics club coordinators and their current high school mathematics teachers. However, due to the Covid-19 global pandemic lockdown protocols, I did not get narrative accounts of learners from their club coordinators, neither did I manage to interview the learners’ current high school mathematics teachers.

Participants in the study wrote their mathematics stories from primary school to high school and after five months they narrated their stories again. It is likely that if I had allowed them more time to reflect, for example by journaling their experiences once every week for a term or two, more detailed and probably different insights of their mathematics journeys from primary to high school would have been received.

Although learners were given the option to use their Home Language in both the written and spoken stories, all of them wrote their stories in English and some mixed English and isiXhosa in their spoken stories. Both the written and spoken stories were short, which I believe points to a lack of confidence on the part of learners as they were using a language that is not familiar and which they associate with formal occasions and learning environments. I further believe that if learners had used their Home Language, which they are more proficient in, they could have produced lengthier, richer and more detailed stories. However, the stories were comprehensive and the parts where they used isiXhosa were most interesting.

That only 21% of the participants in my study chose to do Mathematical Literacy in the FET stage, compared to the national statistics that show that more learners (72%) choose Mathematics Literacy compared to Mathematics, is interesting. Although one is tempted to conclude that most learners who attended SANCP after school mathematics clubs would choose mathematics in the FET stage, the number that I worked with is too small for such generalisation.

The study took the perspective that narrative is identity, but if one were to take a different approach to the same data, they may yield different findings.

## **7.5 POSSIBILITIES FOR FUTURE RESEARCH**

Any piece of research usually raises many more questions than can be answered in a single study. It would be interesting to follow up on this cohort of learners, who participated in SANCP after school mathematics clubs in primary, into post high school spaces and find out their mathematical identities in those spaces and how they characterise the after school mathematics clubs in their adult stories.

Having carried out this research with one group of learners whose common background is their participation in the SANCP after school mathematics clubs in primary school, it would be worthwhile applying similar research strategies with a comparative group of learners who did not participate in any after school mathematics clubs but share the same social background

with the learners who participated in this study. The study would seek to compare the mathematics learner identities of the two groups that were exposed to two different learning environments at the same period of time in primary school. Thus, a research approach that allows an investigation of a larger number of learners and schools where learners have mathematical backgrounds similar to those in this study is suggested.

Although learner stories show that they were afraid of mathematics, and some even hated the subject, most of them chose to continue doing Mathematics when they had an option to choose Mathematical Literacy which is basically easier. It would be fascinating to research why learners opted to continue studying a subject they describe as difficult and one that they hate.

Generation of data for this research was done using written and spoken narratives, where participants were asked to respond in English or any language that they were most comfortable with. It would be interesting to generate both the written and spoken stories in the participants' Home Language, where I believe they would express their ideas and feelings differently from when they use an additional language like English.

Most learners (11/14) in the study demonstrated positive mathematics identities and chose to continue doing Mathematics in the FET stage. More action research is needed to explore how we can support positive mathematics identity development as learners transition into more advanced mathematics in high school.

Furthermore, more studies should also focus on specific teaching methods that support all learners' positive mathematics identity development in primary school. The DBE (2015) notes that "education experts agree that if a child does not learn the basics in Grades 1 to 3, that child will have difficulties in all the later grades."

## **7.6 HOW THIS THESIS CONTRIBUTES TO THE ACADEMIC FIELD**

Research in learner mathematics identity has largely privileged the voice of the classroom teacher, teacher educators and pre-service teachers. Classroom teachers would observe learners in practice and write stories about the learners' mathematics identities.

My study is unique in that it gives learners a voice to tell their own mathematics identity story. The study therefore gives an insight into the learners' mathematics identities from the learners' perspectives. More importantly, the study adds the voice of the underprivileged learners whose voice has previously been largely unheard in research about learner mathematics identities especially in South Africa.

The two analytical frameworks that I used helped me to explore the learners' mathematics identities over the long period of time that stretched from when learners started primary school to high school. This was a novel approach that can be used in future studies and represents a form of contribution of this study to the field.

The main analytical framework developed by Wenger (1998), the Social Ecology of Identity, helped me to tease out the interwoven relationships and interactions within learners participation in primary school, SANCP after school clubs and in high school. It allowed me to explore learners' MLIs as future participators of mathematics or not, engagement and alignment in mathematics activities.

Under the engagement mode, I managed to explain learners' narratives about their participation in mathematics, for example, in group activities or how they experienced challenges that hindered their mathematics practice. The alignment mode is closely linked to the engagement mode where the latter is rarely effective without the former. Learners successful alignment was evident when they managed to recall and apply various rules and regulations of mathematics practice.

The supplementary analytical framework I adapted from Solomon (2009) helped me to discuss experiences that influenced the construction of MLIs in learners' stories. Their stories about the nature of mathematics gave them the opportunity to put mathematics into perspective, for usually, what learners believe about the nature of mathematics control their engagement or disengagement with the subject.

Furthermore, Solomon (2009) posited that stories about how learners position and present themselves as mathematics learners in the landscapes of practice play a pivotal role in the construction of their mathematical identities. For example, stories of confidence in learners' abilities to generate new and meaningful ideas in mathematics were necessary in the development of mathematical understanding. The stories covered learners' engagement in mathematics in different landscapes of practices that promoted the construction of different learner mathematical identities.

## **7.7 FINAL CONCLUSION**

The overall research focused on the centrality of mathematical learner identities in the learning of mathematics in different landscapes of practice. This is primarily because research shows that MLI provides a powerful bridge that links learning and the learners cultural contexts. The

study did not venture into the cognitive deficit discourse of why learners in South Africa perform poorly in mathematics studies.

The rationale of my study was to ascertain the MLIs of high school learners who participated in the SANCP after school mathematics clubs in primary school. Research indicates that MLIs are pertinent as they significantly determine learners' participation and performance in mathematics in school and after they leave school.

In the research I used the Sfard and Prusak (2005b) operationalised definition of identity, that is defined as the collections of stories about persons or, more specifically, as those narratives that are reifying, endorsable and significant.

I then deployed Wenger's (1998) modes of belonging and Solomon's (2009) categories to analyse and code the learners' written and spoken stories, and further analysed their narratives to explore their MLIs.

Overall, the MLIs of love for mathematics, determined endurance amid mathematical challenges, hardworking, and imagination of pursuit of mathematics post high school are all connected to the ethos that learners were exposed to in the SANCP after school mathematics clubs. The ethos included more broadly the concept of making mathematics fun. The clubs were essentially established to promote different MLIs from those typically fashioned in the classrooms, where learners are perceived as passive recipients of knowledge. They also afforded learners the chance to develop more participatory mathematical identities. The clubs became spaces for negotiating future possible mathematical trajectories through discussing and investigating career options and various educational requirements (Graven, 2011).

In the final analysis, all the learners valued the mathematics practice they were exposed to in the SANCP after school mathematics clubs, and explained that they sought external assistance when they faced mathematical challenges even now in high school.

Most learners revealed positive mathematical identities and indicated the need to pursue mathematics related studies post their Grade 12.



## REFLECTION

I borrow from one of the research participants to describe my Ph.D. journey as an exciting, challenging, and fascinating rollercoaster.

I started the journey in 2018, having taught in primary school in my country, Zimbabwe, since 2000. I wanted to study for this degree so much that when I was denied ‘study leave’ I took the most unlikely option, and that also happened to be the last; I resigned and forfeited everything that I had worked for, for close to two decades. This is how much I wanted to study for this degree!

Venturing into a new landscape, where I only knew one person, was some adventure! I had to learn a new way of life. I had to adapt to the new culture of ‘academia’. The learning curve was exciting because I already enjoyed reading. And here I was surrounded by ‘millions’ of reading materials. The availability of learning resources was astounding, and I was excited and quickly immersed myself in mathematical learner identity literature. This was another new landscape for me, but I have no regrets because it is an exciting research area.

Going into the schools was more exciting. I learnt to work with learners with a different language and culture from the learners that I had worked with for close to two decades. I also enjoyed watching the learners learn when I assessed pre-service teachers on their Teaching Practice.

The most challenging part in this journey was to adapt and understand the academic language. I had to read some research papers more than five times in order to understand them. This was different from the reading for fun that I was used to. I had to quickly adjust, but I must confess that I still encounter important papers that I need to read several times in order to understand and make sense out of them.

Reading literature on learner mathematical identity has made me realise that there is more to teaching mathematics than just standing in front of the classroom, working out a few examples on the chalkboard and asking learners to carefully do the same in their workbooks.

Learner mathematics identity is critical in their learning of the subject as it provides a powerful bridge between learning and cultural context. It serves as a means of understanding learner engagement with mathematics and/or their disengagement from the subject.

Reading learners' spoken and written stories has been an eye-opening experience for me. I was pleasantly shocked to realise that learners can have negative mathematics identities, where they describe the subject as hard and difficult and say that they actually hate the subject, but still choose to continue doing it when they are given the chance to switch to another different and less difficult version of mathematics.

Even more surprising was to see learners who chose Mathematical Literacy exhibiting the same MLIs of affinity for the subject and telling stories of resilience in their working.

The most exciting episode in my Ph.D. journey was attending conferences. There I had the chance to meet distinguished academics, some of whom had written research articles that I had had difficulties in understanding. Putting a face to the different research articles that I had read, and actually interacting with some of the writers, was on its own an event of a lifetime for me.

My supervisors were amazing from the first day that we met! The support and encouragement that they gave me throughout the journey have been amazing. Their patience when I struggled with ICT can never be equalled. Before embarking on my Ph.D. journey, I could hardly type, but through their patience and encouragement I managed to type my thesis without enlisting the services of a typist.

Indeed, learning does not stop, for we learn new things every day.

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# **Write your story of yourself as a mathematics learner from Grade 1 to now**

You can tell this story in any way you like – there is no right or wrong way to write this. You can write in any language that you are comfortable writing in – you can even mix languages!

---

If you don't know how to start, close your eyes for a moment and picture yourself as a Grade 1 learning maths . . . Imagine yourself in Intermediate Phase learning maths . . . Think of yourself when you started learning high school maths . . . and think about yourself as a mathematics learner now.

Now write your story...

## APPENDIX B: INTERVIEW SCHEDULES

### INTERVIEW SCHEDULE (Grade 10 learner)

Learner: \_\_\_\_\_

Time at start: \_\_\_\_\_

Can you please tell me your maths story from Grade 1 until now?

#### Has the learner mentioned:

- ☐ Their time in **FOUNDATION PHASE**? If no, “You haven’t mentioned anything about your time in early primary school, can you tell me something about your maths story during that time?”
- ☐ Their time in **INTERMEDIATE PHASE**? If no, “You haven’t mentioned anything about late primary school, can you tell me something about your maths story during that time?”
- ☐ Their **FIRST YEAR OF HIGH SCHOOL** (Grade 8)? If no, “You haven’t mentioned anything about your first year of high school, can you tell me something about your maths story during that time?”
- ☐ **GRADE 9**? If no, “You haven’t mentioned anything about Grade 9, can you tell me something about your maths story during that time?”
- ☐ The **PRESENT (GRADE 10)**? If no, “You haven’t mentioned anything about your maths story from this year. Can you tell me something about your maths story as it is at the moment?”
- ☐ Their **SUBJECT CHOICE**? If no, “You haven’t talked about your choice to do Maths or Maths Lit. Can you tell me that part of your story?”
- ☐ The **FUTURE**? If no, “Can you also please tell me about how you imagine your maths story in the future?”

Time ended: \_\_\_\_\_

## INTERVIEW SCHEDULE (Grade 9 learner)

Learner: \_\_\_\_\_

Time at start: \_\_\_\_\_

Can you please tell me your maths story from Grade 1 until now?

### Has the learner mentioned:

- ☐ Their time in **FOUNDATION PHASE**? If no, “You haven’t mentioned anything about your time in early primary school, can you tell me something about your maths story during that time?”
- ☐ Their time in **INTERMEDIATE PHASE**? If no, “You haven’t mentioned anything about late primary school, can you tell me something about your maths story during that time?”
- ☐ Their **FIRST YEAR OF HIGH SCHOOL** (Grade 8)? If no, “You haven’t mentioned anything about your first year of high school, can you tell me something about your maths story during that time?”
- ☐ The **PRESENT (GRADE 9)**? If no, “You haven’t mentioned anything about your maths story from this year. Can you tell me something about your maths story as it is at the moment?”
- ☐ Their **SUBJECT CHOICE**? If no, “You haven’t talked about your choice to do Maths or Maths Lit. Can you tell me that part of your story?”
- ☐ The **FUTURE**? If no, “Can you also please tell me about how you imagine your maths story in the future?”

Time ended: \_\_\_\_\_



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08/03/2021

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Review Reference: 2019-0217-296

Dear Dr. Pamela Vale

**Title:** Exploring mathematical identities of learners

Principal Investigator: Dr. Pamela Vale

Collaborators: Mr. Wellington Hokonya,

This letter confirms that the above research proposal has been reviewed and **APPROVED** by the Rhodes University Human Ethics Committee (RU-HEC). Your Approval number is: 2019-0217-296

Approval has been granted for 1 year. An annual progress report will be required in order to renew approval for an additional period. You will receive an email notifying you when the annual report is due.

Please ensure that the ethical standards committee is notified should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators. Please also ensure that a brief report is submitted to the ethics committee on the completion of the research. The purpose of this report is to indicate whether the research was conducted successfully, if any aspects could not be completed, or if any problems arose that the ethical standards committee should be aware of. If a thesis or dissertation arising from this research is submitted to the library's electronic theses and dissertations (ETD) repository, please notify the committee of the date of submission and/or any reference or cataloging number allocated.

Sincerely,

**Prof Arthur Webb**

**Chair: Rhodes University Human Ethics Committee, RU-HEC**

cc: Mr. Siyanda Manqele - Ethics Coordinator



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**STRATEGIC PLANNING POLICY RESEARCH AND SECRETARIAT SERVICES**

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Date: 12 June 2019

Mr. Wellington Hokonya

P.O. Box 94

**Grahamstown**

**6140**

Dear Mr. Hokonya

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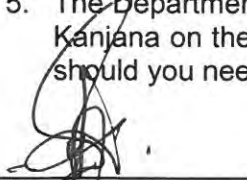
**PERMISSION TO UNDERTAKE A DOCTORAL RESEARCH: EXPLORING THE MATHEMATICAL IDENTITIES OF LEARNERS WHO PARTICIPATED IN AFTER-SCHOOL MATHEMATICS CLUBS**

---

1. Thank you for your application to conduct research.
2. Your application to conduct the above-mentioned research involving over 11-21 participants from 3 selected schools in Grahamstown, Sarah Baartman District of the Eastern Cape Department of Education (ECDoE) is hereby approved based on the following conditions:
  - a. there will be no financial implications for the Department;
  - b. institutions and respondents must not be identifiable in any way from the results of the investigation;
  - c. you seek parents' consent for minors;
  - d. it is not going to interrupt educators' time and task;
  - e. you present a copy of the written approval letter of the Eastern Cape Department of Education (ECDoE) to the Cluster and District Directors before any research is undertaken at any institutions within that particular district;
  - f. you will make all the arrangements concerning your research;
  - g. the research may not be conducted during official contact time, provided that an arrangement to do research at the school including getting inside a classroom has been arranged and agreed upon in writing with the Principal and the affected teacher;



- h. should you wish to extend the period of research after approval has been granted, an application to do this must be directed to Chief Director: Strategic Management Monitoring and Evaluation;
  - i. your research will be limited to those institutions for which approval has been granted, should changes be effected written permission must be obtained from the Chief Director: Strategic Management Monitoring and Evaluation;
  - j. you present the Department with a copy of your final paper/report/dissertation/thesis free of charge in hard copy and electronic format. This must be accompanied by a separate synopsis (maximum 2 – 3 typed pages) of the most important findings and recommendations if it does not already contain a synopsis.
  - k. you present the findings to the Research Committee and/or Senior Management of the Department when and/or where necessary.
  - l. you are requested to provide the above to the Chief Director: Strategic Management Monitoring and Evaluation upon completion of your research.
  - m. you comply with all the requirements as completed in the Terms and Conditions to conduct Research in the ECDoE document duly completed by you.
  - n. you comply with your ethical undertaking (commitment form).
  - o. You submit on a six monthly basis, from the date of permission of the research, concise reports to the Chief Director: Strategic Management Monitoring and Evaluation
3. The Department reserves a right to withdraw the permission should there not be compliance to the approval letter and contract signed in the Terms and Conditions to conduct Research in the ECDoE.
  4. The Department will publish the completed Research on its website.
  5. The Department wishes you well in your undertaking. You can contact the Director, Ms. NY Kanjana on the numbers indicated in the letterhead or email [nelisa.kanjana@ecdod.gov.za](mailto:nelisa.kanjana@ecdod.gov.za) should you need any assistance.



**NY KANJANA**  
**DIRECTOR: STRATEGIC PLANNING POLICY AND RESEARCH**  
**FOR SUPERINTENDENT-GENERAL: EDUCATION**

# My Mathematics Story

CEBISA, Vuyani High School

My Mathematics story so far has been an exciting, challenging and fascinating rollercoaster. It all started at a grade 1 class in North-End Primary School. Maths then was extremely easy and it fascinated me so much (well it still does). ~~and~~ It all started with the easy 1+1 & grades 1 - 2 questions of which I aced. It then leveled up a bit in grade 3. Grade 3 was ~~the~~ <sup>my</sup> most exciting maths year because that when I started Maths Club. with [North-End Club Leader] Maths Club had really set a good maths foundation for me. ~~and in my Maths in grade 4 to~~ ~~was~~ and that's when I realised that I have a love for numbers. Grade 4 - 5 maths was a bit manageable but ~~grade 6 maths~~ when I got to grade 6 that's when Maths started being a little bit challenging. But I battled my way through grade 6 + 7 maths and then I got to high school and that's when Maths took a real turn. First few weeks in grade 8 Maths, I was really overwhelmed with the amount of



difficulty as compared to primary. New concepts had been introduced but I still managed to bag my A's. Then I got to grade 9 and that's when ~~I started crying~~. maths started being real. Here we were introduced to ~~something fun too~~ graphs ~~of which challenged me~~ ~~a lot~~ and many other difficult concepts of which challenged me a lot. ~~When my interest in maths decreased because~~ ~~maths was really~~ Because I had a wonderful teacher who would ~~clearly~~ clearly and explain the work I could still bag some A's of which encouraged me to choose Pure Maths. Grade 10 maths! All I can say about grade 10 maths is wow! Pure maths is no child's play and is very challenging. Sometimes I get so frustrated because I do not understand the new work. ~~My~~ My maths journey hasn't been easy at all but through it all I still love Maths.

||  
)



My journey of Mathematics has been one interesting, fascinating and SURELY CHALLENGING route. From the easy and simple one plus one sums, to the times tables which we had to learn in ~~primary~~ pre-primary which is from grade 1 to 3. I would just simply and easily get an answer by ~~adding~~ using my fingers to add and subtract from the given sums. I remember where we would also count apples, bananas etc. We would get so easy tests on Bonds which were the times tables and we would only get tested on one thing at a time, in other words one maths section at a time. I ~~participated~~ also participated in the Maths Club since I really enjoyed Maths at school. There I was so active and I would really look forward to Maths club every week since we would play Mathematical games and get strategies on how to solve problems. That was grade three. Then came grade four, the intermediate phase where things started being real. We were introduced to factorising, simple algebra etc. I really enjoyed finding Highest common factors and lowest common multiples. Maths in grade four went pretty well since I had a good foundation from my previous pre primary school. In grade five it was quite manageable and grade six too. Then came grade seven where we got into deeper algebra. There were times when I would be so lost in class and even battle in assignments. And in grade seven algebra was a bit of a problem in some sections where there were algebraic fractions, so there my interest in Maths was quite very low due to that. I then started High School in grade 8, I had a very boring and calm Maths teacher. I understood what was going



on in class and I was very engaged. I even understood the grade 7 work that I didn't get and Maths started being a fun subject for me. I would feel very eager to have a Maths period. The following year in grade 9, I was taught Maths by an old and caring teacher. She clearly explained Maths concepts and I would get and understand the work easily. Every Math class I would look forward to what she was going to teach. She would show us solutions to the problems which ~~made us when we saw would be like~~ when I saw, I would be like "Oh WOW!", ~~and that~~ year she made us stretch our minds and I would easily be able to apply concepts ~~to~~ given problems and be able to solve them. Maths therefore in grade 9 for me was very easy and enjoyable. That is where I got to describe Maths as MIND BLOWING. Then there's me now, in grade 10. Mathematics is very interesting. There are sections which when you are introduced to, you easily understand but there are sections where I had to spend days understanding trying to understand after being taught in class. ~~There~~ I had times where ~~to~~ I didn't fully understand some sections and that made me feel very miserable and not want to have Maths and not want Maths periods to happen and cause me to panic. So in grade 10 Maths is not AS FUN as the lower grades since it is more challenging, developed and requires a lot of knowledge and thinking. It is fun and interesting a lot but it is more stressful than it is FUN. ~~Therefore~~ I really enjoy Maths because I learn strategies and it stretches my brain and ~~in the end~~ ~~I enjoy that because~~ makes me able to tackle ~~problems and not more solutions.~~



18 May 2019

## My Story

I remember doing Mathematics at Grade 1, it was very enjoyable and exciting to do. I really enjoyed it at my Pre-years then I was introduced to Maths Club which really made me understand it easily and ways to solve problems. At sometimes Maths could be challenging but I would stay focused and find a way to get through it.

At the Intermediate Phase it started to become hard for me and I used to find help to those around me or former students at my school. Because I'm a hardworking learner, I would take the challenge and try to work it out on my own. I struggled when it became to solving problems like  $(x)$  so I decided when I'm in High School I would do Mathematical Literacy because it is easy for me to understand.

As for now I really enjoy Mathematical Literacy and I think I've made a great decision for myself. Sometimes it could be confusing but I taught myself to ask for help if ~~some~~ it gets hard or confuses me. When I was introduced to it, I thought it was easy so it got rough for me because I used to chill with unlikely friends. So now I'm getting there with the hardwork and effort I'm putting in my work.

18 March 2019

I remember now its almost 9 years ago when I was introduced to maths and that was in foundation phase. At that time maths was fun and easy to do. Then at grade 3 at Mountview Primary we were introduced to maths club where we learnt more about maths and did fun maths exercises.

- Years went by things started to change a bit in grade 4 the maths started to get a bit harder but I managed and passed and went to high school!! At high school I chose maths lit the reason I did so was because I find it hard to solve questions that included solving for  $x$ .
- First lessons of maths lit were great and I found it easy and fun. Our teacher is such a great teacher because he won't like skip to other thing without others that don't follow or understand. My teacher told us that we were going to write a test okay fine I was excited for the test. The day came I forgot how to calculate forgot the formulas but I wrote the test and finished it. After it I was so stressed because I was thinking that I am going to fail but

I did not. I was so happy to see my first term report because I got level 5 for maths and I was so relieved and happy to conclude all I am happy with maths and I enjoy it and I am willing to learn more about maths.



18 May 2019My MATHEMATICS STORY

I remember the first time that I did mathematics. It was in Grade 1, My teacher told me that today we are starting a new thing that ~~we~~ we will need to know and learn it for our rest of our lives. At first math was so fun because we were like counting apples and stuff. then we move to counting  $(1+1)$  I loved doing that kind of stuff.

It was then that in Grade 3 teacher's saw the potential I have in Mathematics and I was selected to be part of the Maths Club in Primary school. I got there and I learned new things and the math in that time was like upgraded, it was not the same as the maths that I was doing in Grade 1. The maths club help me to ~~pe~~ polisher my skills in Maths and I was thought new ways to count ~~of~~ or find answers.

I went throw the intire Primary, then I got to Grade 7 were we were though a New level of mathematics, it was then that I thought that maths was going to be hard because we ~~were~~ were solving not only numbers but letters like (x). I tried it and I saw that nothing was deficalt at all, it was ~~hard~~ fun and challenging but that day I saw that I have love for mathematics. I went to high school in Grade 8 doing the same kind of maths and I was still loving it. Then I had a chance to look back at my old reports and I saw that maths is actually a ~~fun~~ fun subject to do and I was loving it.

Then in Grade 9 maths was like upgraded to another level because it seemed ~~difficult~~ difficult but I ~~ex~~ kept going though I fail ~~the~~ term 1, I tried my best to have a good come back and luckily learned ~~new~~ other new ways to find an answer e.g new formular's. It was then that I decided to carry on doing Mathematics in Grade 10 and for the rest of my life, because maths ~~is~~ is the only subject that I ~~mostly~~ mostly ~~love~~ love.

So I conclude by saying that in my life maths has been a fun and a Challenging subject and also it is my friend. # LOVE MATHEMATICS

18/05/2019

## My story

In Grade 1 when I started doing maths I hated it because I was always told that maths is hard so I had that mind set. My maths teacher helped me to change that mind set she showed me just because people think maths is hard does not mean it should be hard to me too. ~~As I grew up~~

As I grew up I started to develop love for maths I enjoyed maths because it challenged and pushed me to the limits. In grade 3 I then joined maths club My love for maths grew and I started practising maths every day because I wanted to solve **Club Leader 1** maths problem and that has always motivated me to be the best maths student I can be.

When maths club ended My sister helped me to practise maths and She was doing grade 12 then, but I wanted to know more and learn new Maths skills every day.

In Grade 7 and 8 maths started being more difficult and every one was scared of maths and people kept on wishing that they could change maths, but I saw this as ~~a~~ a chance to test my self so I practised maths harder than ever until I got



to a point where I was so good in Maths that my previous School sent me around the town and province doing maths ~~competitions~~ competitions.

In high school every thing changed. I met people who also love Maths and that I loved because we helped each other because maths starting from grade 9 started being super difficult and we stayed together and worked as a team and we were able to pass Math and my love and passion for maths never ended so I chose to do ~~Math~~ Math in grade 10 so my story still ~~continues~~ continues

18 May 2019

## My Days with MATHS Club

When I started learning in S. Msholozzi Primary I joined the Maths Club but I didn't join it my teacher [REDACTED] took me to the Maths Club. At first I never liked maths it was the only subject I hated.

But when I joined the Maths Club it made me realize that Maths isn't that hard ~~but~~ <sup>and</sup> it is not about getting the right answer, but it was about understanding it, ~~and~~ making everything fun and coming up with great new ideas on how to solve maths problems.

I've been attending the Maths Club since 2013/2014 until 2017. Since then I loved Maths more and more, it became my favourite subject. And guess what all the years that I have been attending the Club I was getting certificates for Maths because I was one of the Top learners in Maths.

What I loved about Maths <sup>Clubs</sup> is that they Club Leader 1 and Club Leader 2 gave us time and always used the words "Make Maths Fun". In everything I did that has something to do with Maths I would think of Club Leader 1 and Club Leader 2 words.



I really appreciate everything that Club Leader 1 and Club Leader 2 did for me, because they did not start the Clubs I would be hating and failing Maths. One day I will make them proud of me.

Now I'm in Highschool things are tough because they are not there to help us and inspire us. But still trying trying to work hard and learn fast because the skills we developed from their Maths Clubs. But we still need and want the Maths clubs to start again if that's possible. But still I appreciate everything <sup>that</sup> Maths Clubs have done for us.

From: LINDELWA, Sikelela High School

## My journey to Maths Club

When I first arrived in the school namely

Icawa Primary School

I wasn't a good catcher when it comes to learning Maths. I met a friend whom usually helped me with my Maths homeworks, because she was a bit older than me and was excelling in Maths.

I wasn't excelling in it nor understanding it. I chose to give up and quit school if they were to teach me Maths. My helper usually came to my house to show me some tricks, but it only took me a year to understand Maths.

When I wrote my Anna exam I was not sure if I could get it right and pass my exam but with God's grace I passed it with flying colours and got a level 7 that it gave me power to love and to continue doing it till I loved it.

I went to the next which was Grade 2 I was excelling in it and I was one of the toppest student. My teacher taught me tricks that were going to challenge me in the next grade.

In grade 3 I was given a certificate for Maths and I was given an award. My teacher bought me a chocolate. I was passing maths



from that year till I got to

S. Msholozzi Primary

In Grade 4<sup>which</sup> I was doing at

S. Msholozzi Primary

class teacher was

Grade 4 teacher

and my maths teacher

was also

Grade 4 teacher

I <sup>then</sup> was chosen by

Math teacher

because of my good marks in maths.

When I first heard the word "Maths Club" I knew

that it was all about fun and learning tricks of

maths. Our maths club teacher was

Leader 1

who taught us nothing but good about maths and taught

us tricks about maths which we used to teach

other learners in class. I wasn't sure about the

fact that I was chosen to be in the club.

Leader 1

did a good work by inspiring us and was a good example to us. She took us as her children and we took her as our mother. In 2016 was

when

Leader 1

came to introduce us to

Leader 2

we worked very good with her and

Leader 2

They

told us that maths could get us far. I passed Maths from those years until I finished Primary.

I was then going to start my higher grades

at

Sikelela High School

there I forgot everything that

Leader 1

and

Leader 2

taught me. It was very hard at the beginning

that I even failed my first term of High School.

After I saw my results from the first term I

told myself that I will again be the same

person I was in Primary.



I then began to be the same person I was in Primary until today. I'm a good maths learner and I'm very proud of myself.

18 May 2019

## My Mathematics Story

It was almost a decade ago when my first love for Maths developed. In Grade 1, everything was easy, everything came to me easy. In foundation phase Maths was so easy, it didn't need much thinking. In intermediate phase (Grade 4 - 6) some of the equations and the standards became harder. We started learning multiplication and division. What made it fun was the mental maths we used to do with our teacher every morning. I had the most difficult time in grade 9. Everything I learned was painful to me. I even dropped on my marks, unlike others grade. In grade 10, I told myself, this year is the year where I show my potential.

## My journey with Mathematics

When I was first introduced to Maths I in grade: 1, I was not so sure that I liked it or not. But as the years went by I started to understand and love Mathematics.

In grade 2 I started to get great marks in maths, because that's when I was beginning to understand maths. When ever I got something wrong in a sum I would get frustrated because I always wanted to get everything right. But my father thought me that I should understand I won't get everything right all the time. The only thing I should do is practise every day.

Then in grade 3 my teacher selected me to be one of the 4 other member in a maths club. The clubs where very enjoyable, and there were fun games we played. Club Leader 1 made us play around with maths and I began to love maths even more. After that I started getting surtificates for maths.



In grade 6 we were given there bad news that math club will be no more. Those were not the greatest things we had ever had. In grade 8 maths was starting to be more difficult for me because I'm a slow learner and my teacher did not want to always explain to me. But I tried my best to pass, and so I did.

When I first arrived in High School this were more complicated. Maths was a lot harder then before but I thought myself to work hard and practise everyday. And now I get great marks, and II Maths club really helped me in Mathematics a lot. We Thank you for everything.

From: **AKHONA, Mtambo High School**

# Mu Story

FUNEKA, Mtambo High School

I remember in grade 1 in 2011 ~~my~~ I was struggling with my maths. I could't find the difference between the signs of addition, subtraction, multiplication and division. At the time my mom was helping me by bringing bottle lids so that she can help me to work. After I was able to know the signs. When I started in the intermediate phase I was struggling again because maths was not the same we were working with big numbers and ~~she~~ I was confused when it comes to ~~be~~ using the column when multiplying. But we were asked if we want to attend the maths club with **Club Leader 1**:

I didn't want to go to maths club because after school I was getting hungry and in the club we were doing some work for an hour. I made my final <sup>decision</sup> to attend the club because I really need help. So I attended the club so things we better because **Club Leader 1** was keeping asking which ~~exp~~ chapter we are struggling with and help us with that by playing games. After joining the club I saw that my results are changing and they are increasing.

In 2017 I was doing grade 7 and Maths was very very tough because grade 7 is not such an easy grade. My marks on Maths were ~~increas~~ decreasing but the club helped I'm so grateful because in 2017

**Club Leader 2** was the one who was controlling the club but she kept on giving us tests which really helped a lot. At the end of the year I was happy with maths results thanks to the club.

In grade 8 in 2018 ~~we~~ <sup>I</sup> ~~were~~ <sup>was</sup> doing Maths which was not that hard but it was understandable and enjoyable but sometimes it was very tricky, but we ~~getted~~ <sup>got</sup> help ~~for~~ <sup>from</sup> learners from Vuyani who were doing grade 10 that year they really helped their help is appreciated, they were coming every Tuesday just like the club in primary. Now I'm doing grade 9 and maths is a little bit hard especially when it comes to geometry but the Vuyani girls are helping and I think there will be change so that I will choose Pure maths in ~~graders~~ <sup>grades</sup> 😊



## My maths story

I started primary in 2011 that year I was doing gr 1. At that time maths was fun and extremely easy because we were just adding small numbers and subtracting. At that stage we used anything to calculate we used bottle tops and fingers etc. At gr 3 we used to do mental maths where the teacher gives us a statement and we calculate without writing down. In 2014 I was doing gr 4 there was a lot of work done comparing to gr Int foundation phase. It's when I started maths club, in the maths club we had an opportunity to count using cards using ~~some~~ and we used very exciting maths activities. I loved the maths club because it was making us clever because we had maths tricks that we used while doing an activity.

During the club there was a time where we had a test before the term ends we solved some issues and math problems. In gr 7 maths became more harder and there was a lot of work done there came solving ~~a~~ variables geometry and so on. The maths is fun but you need to focus that's the rule I told my self while was going to high school and If you practise maths then you will achieve. Gr 8 math is light and was hard at the same time that maths confused me sometimes and as the time goes I achieved a lot and the only term that

I struggled was term 1 where I had level 3 but term 2 I upgraded. There was no one no extra class like the maths club I felt ~~alone~~ alone without the maths club in the new school. In yr 9 my maths was fun it ~~was~~ is challenging. It is very exciting because ~~you~~ <sup>I</sup> compete with ~~your~~ my friends and help each other with our maths problems. I wish we have the same club even here in high school and carry on with the helping club.



# My maths story

In grade 1 2011 I was struggling to do maths because I was 9 years old. I was taught by

Teacher A at S. Msholozzi Primary

so I didn't understand how to count the maths. My help to count maths I used to use toothpicks as numbers. I ~~subtract~~ subtract the stick without using getting help from my mother or father. I couldn't understand the difference between the signs of multiplication, subtraction, ~~it~~ and adding. In grade 3 we were not allowed to use ~~calculator~~ calculators so I started Maths with

Club Leader 1

Every morning in class we use to make registration of maths. We used to stand by the wall, if the teacher asks you then you must answer. We were attending Maths Club in Tuesdays at 14:30pm ~~of~~ afterschool. In

Teacher A's

class we used to go outside to play maths game. In grade 7, I used to struggle because it was a little bit hard because it was my first time solving ~~2D's~~ 2D's and I couldn't understand how to solve them.

~~After~~ I talked to

Club Leader 2

about the issue about how to solve 2D's, she helped me. Also I used to

get lost to make the difference of 2D shape and 3D. Maths Club of

Club Leader 1

Club Leader 2

helped me, because in class I couldn't get enough explanation. So I thought about Maths Club.

In every term before it ends we were given ~~to~~ tests to write so they can see <sup>we</sup> were ~~not~~ listening over the term. ~~Me~~ Me and

Esihle

over the end of year we received maths box full of different shapes with elastics so you can add and gives you 2D shape.

In grade 9 I struggle a lot, I won't lie 😊  
because I couldn't hear the teacher when he  
was teaching. Then I was asked ~~for~~ the maths teacher  
the other one, that can't she get <sup>us</sup> some ~~people~~ <sup>people</sup> learners  
to help us with maths. Then she got some learners  
of Vuyani to help us. It's been 2 ~~new~~ months  
now since I was attending. MATHS IS FUN!!!  
Mathematics was helpful to me a lot!!

KHETHIWE, Mtambo High School



# My maths story

I started school in grade 1 at **Makhanda Primary** Primary and I was taught maths by **Makhanda Primary teacher** - best teacher ever! At first I was confused by Maths. I couldn't tell the difference between addition and subtraction but with the help of my parents and my teacher, I finally could tell the difference between the two. In the next year I went to grade 2. I was really excited because it was my first time in grade 2, but all that excitement came to an end. Maths was a little hard in grade 2 than in grade 1. During the first term I would get low marks and I would get <sup>is</sup> feel bad about myself. I asked my mom, who ~~was~~ <sup>is</sup> really good at maths to help me and a little while later, I was slowly getting there. I was good at maths until the last term. In grade ~~3~~ <sup>and</sup> 4, I was still good at maths, a little less in grade 4 because of multiplication and subtraction, I was new <sup>in</sup> those. In grade 5 <sup>2015</sup> I went to a new school, **S. Msholuzi Primary School**. At first, I was shy because I never really knew anyone at that time. I think it was in term 2 when my classmate, **Non-participant** went to another school. **Non-participant** was a maths club member before he left and my teacher suggested that I go to the maths club class and replace lithemba. I asked my other classmate **Zimkitha** to accompany me because I was really scared that



would

Club Leader 1

chase me out of the match maths club. I got there and Club Leader 1 welcomed me. I was shy at first but then I got eased up. The maths club really helped improve my maths skills and I will be always grateful for that.

APPENDIX S: The narrated nature of mathematics in Primary versus High school

| Learners                                                                                                                                                                                          | Written narratives describing of the nature of mathematics                                                                                                                                                                                                                                                                                                                   | Spoken narratives describing of the nature of mathematics                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Aphiwe                                                                                                                                                                                            | <p>I remember doing mathematics at Grade 1, it was very enjoyable and exciting to do. (Written, 1)</p> <p>Maths could be challenging. At the Intermediate phase it started to become hard for me. (Written, 3-4)</p> <p>...I would do Mathematical Literacy because it is easy for me to understand. (Written, 7).</p> <p>Sometimes it could be confusing. (Written, 9).</p> | <p>From grade 1, maths was very fun and easy to solve because I was getting used to school and stuff, so I enjoyed maths from grade 1, and when the years were passing, so grade 2 was fun and I really enjoyed maths.</p> <p>Even grade 3, there was starting to be a little bit of difficulty. (Spoken, 1-2)</p> <p>...then from grade 8 I dropped in maths from grade 8 because it was really difficult ...maths is challenging. (Spoken, 4-5)</p> |
| <p><b>Primary mathematics</b> (enjoyable, exciting, fun, fun, challenging, a little bit of difficulty, hard)</p> <p><b>High school mathematics</b> (confusing, really difficult, challenging)</p> |                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Sisipho                                                                                                                                                                                           | <p>At that time maths was fun and easy to do. (Written, 2)</p> <p>[G]rade 7 the maths started to get a bit harder. (Written, 4)</p> <p>First lessons for maths lit were great and I found it easy and fun. (Written, 6)</p>                                                                                                                                                  | <p>First of all, in grade 1 it was all easy stuff until grade 3. (Spoken, 1)</p>                                                                                                                                                                                                                                                                                                                                                                      |
| <p><b>Primary mathematics</b> (fun, easy, harder)</p> <p><b>High school mathematics</b> (fun, easy)</p>                                                                                           |                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| <b>Zimkhitha</b>                                                                                                 | <p>They told us that Maths could get us far. (Written, 21)</p> <p>It was very hard at the beginning that I even failed my first term of High School. (Written, 25)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <p>[I]t was kind of easy. (Spoken, 2)</p> <p>[I]t was so easy. ...it was a bit harder...(Spoken, 5-6)</p> <p>[I]t's tough. (Spoken, 7)</p> <p>...maths is confusing...( Spoken, 9)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <p><b>Primary mathematics</b> (easy, tough)</p> <p><b>High school mathematics</b> (harder, tough, confusing)</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Lulu                                                                                                             | <p>In grade five it was quite manageable and grade six too. (Written, 13).</p> <p>And in grade seven algebra was a bit of a problem in some sections where there were algebraic fractions... (Written, 16)</p> <p>Maths started being a fun subject for me. (Written, 18)</p> <p>Maths therefore in grade 9 for me was very easy and enjoyable. (Written, 25)</p> <p>That is where I got to describe Maths as MIND BLOWING. (Written, 26)</p> <p>Mathematics is very interesting. (Written, 28)</p> <p>So in grade 10 Maths is not AS FUN as the lower grades since it is more challenging, developed and requires a lot</p> | <p>So in grade 1 it was my first maths, so in grade 1 I experienced maths and it was like actually fun and all, because it wasn't like, I didn't really have to apply much knowledge to solve the sums and that stuff, because it was just simple maths; ok 1 plus 1 and then also using pictures to like work out sums. (Spoken, 1)</p> <p>And then grade 2 it was pretty much the same thing; it was all fun.</p> <p>And then grade 3, it was also pretty much the same thing, at least it was notch up a bit to a higher level. (Spoken, 2-3)</p> <p>I found it interesting... (Spoken, 5)</p> <p>Then in grade 7 we were introduced to different other things, then that's when it started being serious, because we were also going to move onto high school. (Spoken, 7)</p> <p>[I]t is a difficult subject after all. (Spoken, 14)</p> |

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|                                                                                                                                                                                                                          | <p>(of) knowledge and thinking. (Written, 31)</p> <p>It is fun and interesting a lot but it is more stressful than it is FUN. (Written, 32)</p>                                                                                                                    | <p>Then in grade 10 maths is ok, but then there's a big shift from grade 1, 2, 3, 4 to now. (Spoken, 16)</p> <p>It's not as exciting, especially because I'm doing mathematics not pure maths so yah. (Spoken, 17)</p>                                                      |
| <p><b>Primary mathematics</b> (manageable, a problem, interesting, serious )</p> <p><b>High school mathematics</b> (fun, easy and enjoyable, MIND BLOWING, interesting, ok, challenging, difficult, not as exciting)</p> |                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                             |
| Akhona                                                                                                                                                                                                                   | <p>In grade 8 maths was starting to be more difficult for me... (Written, 13)</p> <p>When I first arrived in high school this was more complicated. (Written, 15)</p> <p>Maths was a lot harder. (Written, 16)</p>                                                 | <p>And then I saw that maths is kind of hard but really challenging but fun at the same time. (Spoken, 4)</p> <p>So, when I went on with maths in grade 5, grade 6 I did pretty well and then when I got to high school it got a bit tough and challenging. (Spoken, 6)</p> |
| <p><b>Primary mathematics</b> (fun, hard, challenging)</p> <p><b>High school mathematics</b> (difficult, complicated, harder, tough, challenging)</p>                                                                    |                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                             |
| Anathi                                                                                                                                                                                                                   | <p>In grade 1, everything was easy, everything came to me easy. (Written, 2)</p> <p>In foundation phase Maths was so easy, it didn't need much thinking. In intermediate phase (Grade 4-6) some of the equation and the standard became harder. (Written, 3-4)</p> | <p>Up to now I can say from grade 1 it was like easy... (Spoken, 1)</p> <p>...that's a little more difficult than the one you were given as an example. (Spoken, 4)</p> <p>...it is a bit difficult... (Spoken, 8)</p>                                                      |
| <p><b>Primary mathematics</b> (easy, harder)</p>                                                                                                                                                                         |                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                             |

**High school mathematics (difficult)****Cebisa**

Maths then was extremely easy and it fascinated me so much (well it still does). (Written, 3)

...grade 6 that's when maths started being a little bit challenging. (Written, 8)

Pure Maths is no child's play and is very challenging. (Written, 17)

...it wasn't really intense, it was very easy.

It was all straightforward, yeah.

...but it was really fine. (Spoken, 1-3)

And then grade 4 maths was challenging, because maths club was over then, as she left. (Spoken, 8)

And then grade 4 maths was a bit tricky, cause I'm from grade 3 obviously, and but it was fine, it was a bit challenging. (Spoken, 10)

Yeah, grade 7 maths, yeoh, yeoh, it was challenging. (Spoken, 15)

It was really preparing me for high school, it was so hard I don't know. (Spoken, 17)

... so it was really hard to wrap my head around it. (Spoken, 18)

Um grade 8 maths, yeah, hayi ke, high school, it came with a bang, because I didn't expect it, like it was, the amount of work and the intensity, because it was both hard and a lot. Grade 8 maths was interesting... (Spoken, 20- 21)

[I]t's really hard. (Spoken, 24)



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|                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                     | <p>Yah grade 10 maths is nice. (Spoken, 28)</p> <p>....as I go up it's getting harder and harder...(Spoken, 31)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p><b>Primary mathematics</b> (easy, fascinated me, challenging, straight forward, fine, tricky, hard)</p> <p><b>High school mathematics</b> (interesting, nice, no child's play, very challenging, hard and a lot harder)</p> |                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Ayabonga</b>                                                                                                                                                                                                                | <p>At first math was so fun... (Written, 3)</p> <p>[M]aths is actually a fun subject to do. (Written, 11)</p> <p>So I conclude by saying that in my life maths has been a fun and a challenging subject and also it is my friend. (Written, 14)</p> | <p>...maths was quite fun and it was easy... (Spoken, 1)</p> <p>...then in grade 3 it was quite challenging because we, they added like multiplication stuff and everything... (Spoken, 3)</p> <p>I didn't see any difficulty in maths, grade 4, grade 5, it was like fun... Then grade 6&amp;7 ah hey, that was the year we got to solve x and stuff, so it was quite difficult for me because I was learning new things....(Spoken, 5-6)</p> <p>[B]ut in grade 10 it's quite challenging... it was quite difficult for me...(Spoken, 13-14)</p> <p>In future, ah, this past few weeks I asked my teacher how maths will be in grade 11 and he didn't even, like <i>beat around the bush</i> he told me straight that it will be hard. (Spoken, 18)</p> |
| <p><b>Primary mathematics</b> (fun, easy, challenging, difficult)</p> <p><b>High school mathematics</b> (fun, challenging, difficult, hard)</p>                                                                                |                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Nkosi</b>                                                                                                                                                                                                                   | <p>In grade 7 and 8 maths started being more difficult and everyone was scared of maths... maths starting from grade 9 started being super difficult (Written, 10-11)</p>                                                                           | <p>Okay, from grade 1 I loved maths because then maths was easier than it is now...(Spoken, 1)</p> <p>Grade 9, eish, that was the hardest year, maths, it was very hard. (Spoken, 9)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p><b>Primary mathematics</b> (easier, difficult)</p> <p><b>High school mathematics</b> (difficult, hard)</p>                                                                                                                  |                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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| <b>Esihle</b>                                                                                                                                                    | <p>[M]aths was fun and extremely easy. (Written, 2)</p> <p>In grade 7 maths became more harder and there was a lot of work done, there came solving x variables geometry and so on... maths is fun. Grade 8 maths is light and was hard at the same time that maths confused me sometimes...(Written, 9-11)</p> <p>In grade 9 my maths was fun it is challenging. It is very exciting...(Written, 13-14)</p> | <p>Okay, from grade 1 maths was fun...</p> <p>It was very easy then as the time goes, as the grade are growing up it started being difficult but not that difficult, easy to do...(Spoken, 1-2)</p> <p>...it was challenging yeah. (Spoken, 6)</p> <p>...it was very challenging. (Spoken, 7)</p> <p>I'll be doing maths because it is very fun. (Spoken, 9)</p> |
| <p><b>Primary mathematics</b> (fun, easy, harder, difficult, challenging)</p> <p><b>High school mathematics</b> (fun, light, hard, confused me, challenging)</p> |                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Khethiwehlile</b>                                                                                                                                             | <p>MATHS IS FUN!!!</p> <p>Mathematics was helpful to me a lot!! (Written, 22-23)</p>                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                  |
| <p><b>Primary mathematics</b></p> <p><b>High school mathematics</b> (fun, helpful)</p>                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Lisa</b>                                                                                                                                                      | <p>I was confused by Maths. (Written, 2)</p> <p>Maths was a little hard in grade 2 than in grade 1. (Written, 6)</p>                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                  |
| <p><b>Primary mathematics</b> (confusing, hard)</p> <p><b>High school mathematics</b></p>                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Funeka</b>                                                                                                                                                    | <p>In 2017 I was doing grade 7 and maths was very very tough because grade 7 is not such an easy grade. (Written, 11)</p>                                                                                                                                                                                                                                                                                    | <p>Okay, in grade 1 maths was very easy because we were using bottle lids to count when we were doing addition or</p>                                                                                                                                                                                                                                            |

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|                                                                                                                                             | <p>In grade 8 in 2018 I was doing maths which was not that hard but it was understandable and enjoyable but sometimes it was very tricky...maths is a little bit hard especially when it comes to geometry (Written, 14-15).</p> | <p>subtraction. It was not that hard. (Spoken, 1-2)</p> <p>In grade 4, the maths started to be hard because we were no longer using the bottle lids to count and then we joined the maths club in 2014. (Spoken, 4)</p> <p>It was hard in grade 7 because we were doing division and multiplication with big numbers. It was very hard. In grade 8 it was very hard. (Spoken, 7- 9)</p> <p>Most careers need maths. (Spoken, 13)</p> |
| <p><b>Primary mathematics</b> (easy hard tough)</p> <p><b>High school mathematics</b> (hard, understandable, enjoyable, tricky)</p>         |                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Lindelwa</b>                                                                                                                             | <p>[M]aths isn't that hard and it is not about getting the right answer, but it was about understanding. (Written, 3)</p>                                                                                                        | <p>...it wasn't that hard. ...it's very tough. (Spoken, 7-8)</p> <p>...grade nine is still tough it's tough.</p> <p>I'm going to do maths, because if I do maths there are many opportunities that I have and I think maths, maths is better than maths lit. (Spoken, 11-12)</p>                                                                                                                                                     |
| <p><b>Primary mathematics</b> (isn't that hard)</p> <p><b>High school mathematics</b> (isn't that hard, maths is better than maths lit)</p> |                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                      |

APPENDIX T: Connecting MLIs to engagement and alignment

| <b>Learners</b>    | <b>Articulated mathematical identities in the narratives</b>                                                                                                    | <b>Mathematical learner identities</b>                               |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| <b>Aphiwe. 10</b>  | ‘...I’m a hardworking learner.’ (Written, 5)                                                                                                                    | -A hardworking mathematics learner (+ve) E                           |
|                    | ‘...I really enjoy Mathematical Literacy...’ (Written, 7)                                                                                                       | -A learner who enjoys M.L (+ve) I E                                  |
|                    | ‘...I enjoyed maths from grade 1...’ (Spoken, 1)<br>‘...I really enjoyed maths’ (Spoken, 1)                                                                     | - A learner who enjoys mathematics in primary (+ve) I E              |
|                    | ‘...I dropped in maths from grade 8 because it was really difficult’ (Spoken, 4)                                                                                | -A learner who struggles with high school mathematics (-ve) I E      |
| <b>Sisipho 10</b>  | ‘...I managed and passed and went to high school!!’ (Written, 4)                                                                                                | -A competent learner (+ve) A                                         |
|                    | ‘...I passed all terms getting good marks in maths’ (Spoken, 3)                                                                                                 | -A learner who does well in M.L. (+ve) A                             |
|                    | ‘First lessons for maths lit were great and I found it easy and fun.’ (Written, 6)<br>‘...I enjoy it and I am willing to learn more about maths.’ (Written, 11) | -A learner who enjoys and finds M.L easy (+ve) E I                   |
|                    | ‘...I chose maths lit in grade 10...’ (Spoken, 5)                                                                                                               | -A chooser of M.L. (+ve) E                                           |
|                    | ‘...I struggled a bit, yes in grade 9’ (Spoken, 3)<br>‘...I find it hard to solve questions that included solving for x.’ (Written, 5)                          | -A learner who struggles with some concepts in high school (-ve) E A |
| <b>Zimkhitha 9</b> | ‘...I wasn’t a good catcher when it comes to learning maths’ (Written, 1)                                                                                       | -A slow mathematics learner (-ve) E                                  |
|                    | ‘I wasn’t excelling in it or understanding it’ (Written, 3)                                                                                                     | -A learner who struggles with mathematics (-ve) E A                  |
|                    | ‘I chose to give up and quit school if they were to teach me Maths’ (Written, 4)                                                                                |                                                                      |
|                    | ‘...I was not good in maths, so I was struggling a lot’ (Spoken, 1)                                                                                             |                                                                      |

# APPENDIX T: Connecting MLIs to engagement and alignment

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|                   | <p>‘...I was given a certificate for maths and I was given an award’ (Written, 9)</p> <p>‘I passed maths from those years until I finished Primary’ (Written, 22)</p> <p>‘I am good maths learner and I’m very proud of myself’ (Written, 28)</p> <p>‘...I passed it with flying colours...’ (Written,6)</p> <p>‘...I was excelling in it and I was one of the toppest learner’ (Written, 7)</p>                                                                                                                                                                                               | -An excellor in mathematics E A (+ve)                                            |
|                   | <p>‘...I understand the things of maths lit, not pure maths things I’m good in things of maths lit’ (Spoken, 8)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | -An excellor in Mathematical Literacy (+ve) E AC                                 |
| <b>Lulu. S 10</b> | <p>‘...I had a very loving and calm Maths teacher’ (Written, 16)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | -A lover of mathematics (+ve) I                                                  |
|                   | <p>‘I would feel very eager to have a maths period’ (Written, 19)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                  |
|                   | <p>‘...I really <b>enjoyed</b> Maths at school’ (Written, 6)</p> <p>‘...I was so active and I would really look forward to Maths club every week...’ (Written, 7)</p> <p>‘I really <b>enjoy</b> Maths because I learn strategies and it stretches my brain and makes me able to tackle problems’ (Written, 33)</p> <p>‘...I really <b>enjoyed</b> algebra and all the other kinds of stuff...’ (Spoken, 5)</p> <p>‘...I really <b>enjoyed</b> maths because the teacher that taught maths was very enthusiastic...’ (Spoken, 8)</p> <p>‘...I <b>enjoyed</b> finance maths...’ (Spoken, 12)</p> | -A learner who enjoys mathematics                                                |
|                   | <p>‘I understood what was going on in class and I was very engaged’ (Written, 17)</p> <p>‘...I would easily be able to apply concepts to given problems and be able to solve them’ (Written, 24)</p>                                                                                                                                                                                                                                                                                                                                                                                           | -A learner who understands mathematics concepts in high school easily. (+ve) A E |

# APPENDIX T: Connecting MLIs to engagement and alignment

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|                  | ‘I had times where I didn’t fully understand some sections and that made me feel very miserable and not want to have Maths and not want Maths periods to happen and cause me to panic’ (Written, 30) | -A learner who felt miserable when she failed to understand mathematics concepts (-ve) A E |
|                  | ‘...I get lazy at times and I feel like maths needs your full on attention’ (Spoken, 20)                                                                                                             | -A lazy mathematics learner. (-ve) I                                                       |
| <b>Akhona 10</b> | ‘...I started to understand and love mathematics’ (Written, 2)                                                                                                                                       | -A lover of mathematics (+ve) I                                                            |
|                  | ‘...I still choose maths in each and every subject I do’ (Spoken, 7)                                                                                                                                 |                                                                                            |
|                  | ‘Debbie made us play around with maths and I began to love maths even more’ (Written, 9)                                                                                                             |                                                                                            |
|                  | ‘...I really liked maths, love it’ (Spoken, 1)                                                                                                                                                       |                                                                                            |
|                  | ‘Whenever I got something wrong in a sum I would get frustrated because I always wanted to get everything right’ (Written, 4)                                                                        | -A learner who wants to succeed in all mathematical problems (+ve) E I                     |
|                  | ‘...I tried my best to pass and so I did’ (Written, 14)                                                                                                                                              | -An excellor at mathematics (+ve) A E                                                      |
|                  | ‘...I started getting certificates for maths’ (Written, 10)                                                                                                                                          |                                                                                            |
|                  | ‘...I’m a slow learner and my teacher did not want to always explain to me’ (Written, 13)                                                                                                            | -A slow mathematics learner (-ve) I                                                        |
|                  | ‘...I taught myself to work hard and practice every day’ (Written, 16)                                                                                                                               | -A resilient learner. (+ve) E                                                              |
|                  | ‘I’m doing good (sic) but it’s not what I actually want, and I want to do pure maths in grade 10...’ (Spoken, 9)                                                                                     | -A learner perceives mathematics as challenging but fun (+ve) E I                          |
|                  | ‘...I saw that maths is kind of hard but really challenging but fun at the same time’ (Spoken, 4)                                                                                                    |                                                                                            |
|                  | ‘...I like challenges and stuff’ (Spoken, 5)                                                                                                                                                         |                                                                                            |
| <b>Anathi 10</b> | ‘I had the most difficult time in grade 9’ (Written, 7)                                                                                                                                              | -A learner who struggled with some concepts in high school (-ve) E A                       |

# APPENDIX T: Connecting MLIs to engagement and alignment

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|                  | <p>‘I got a certificate which proven that I was the top learner who achieved in maths’ (Spoken, 2)</p> <p>‘I never had a real hard time in the intermediate phase, in primary as a whole’ (Spoken, 3)</p>                                                                                                                                | A competent learner (+ve) E A                                                              |
|                  | ‘I understood the teacher that was teaching me’ (Spoken, 7)                                                                                                                                                                                                                                                                              | -A learner who understands teachers when they teach her (+ve) E A                          |
| <b>Cebisa 10</b> | ‘...I battled my way through grade 6 and 7 maths...’ (Written, 9)                                                                                                                                                                                                                                                                        | -A resilient learner. (+ve) E                                                              |
|                  | ‘Sometimes I get so frustrated because I do not understand the new work’ (Written, 18 )                                                                                                                                                                                                                                                  | -A learner who struggled in primary school (-ve) E A                                       |
|                  | ‘New concepts had been introduced but I still managed to bag my As’. (Written, 11 )                                                                                                                                                                                                                                                      | -An excellor at mathematics (+ve) A                                                        |
|                  | ‘I absolutely hated algebra, yeah I hated algebra...’ (Spoken, 13)                                                                                                                                                                                                                                                                       | -A hater of mathematics                                                                    |
|                  | ‘My maths journey hasn’t been easy at all but through it all I still love Maths’ (Written, 19)                                                                                                                                                                                                                                           | -A lover of mathematics (+ve) I                                                            |
|                  | <p>‘...I have a love for numbers’ (Written, 7)</p> <p>‘...I loved maths...’ (Spoken, 4)</p> <p>‘...I loved numbers specifically...’ (Spoken, 4)</p> <p>‘...I loved grade 9 maths, even though it was really hard, I loved it, loved loved loved’ (Spoken, 23)</p> <p>‘...I absolutely loved graphs and finance...’ (Spoken, 22)</p>      |                                                                                            |
|                  | <p>‘I think I enjoy grade 10 maths a lot’ (Spoken, 30)</p> <p>‘I really love subjects that make you think, like I love being challenged, so yah, I think that’s why I also love maths, because I love being challenged, I love to think outside the box’ (Spoken, 33)</p> <p>‘I also love having to think and sweat...’ (Spoken, 34)</p> | -A learner who enjoys difficult mathematics because she thrives under challenges (+ve) E I |

APPENDIX T: Connecting MLIs to engagement and alignment

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| <b>Ayabonga<br/>10</b> | <p>‘...I was selected to be part of the Maths Club in Primary School.’ (Written, 4)</p> <p>‘...I was quite good at it that I was even picked up to join maths clubs since they saw that my results are, excellent in maths’ (Spoken, 3)</p>                                                                                                                                                                                                                     | -An excellor at mathematics who was picked to join the SANCP after school Mathematics Club. (+ve) A E      |
|                        | <p>‘...I have love for mathematics’ (Written, 9)</p> <p>‘...I saw that maths is actually a fun subject to do and I was loving it’ (Written, 11)</p> <p>‘I love maths, every time I get home I practise, now and again’ (Spoken, 5)</p> <p>‘...I decided to carry on doing Mathematics in Grade 10 and for the rest of my life, because maths is the only subject that I mostly love’ (Written, 13)</p> <p>‘...I will keep on doing pure maths’ (Spoken, 19)</p> | -A lover of mathematics (+ve) I                                                                            |
|                        | <p>‘...I kept going thou (sic) I fail term 1, I tried my best to have a good come back...’ (Written, 12)</p> <p>‘...I will work hard and do my best so that I can improve on my levels...’ (Spoken, 22)</p>                                                                                                                                                                                                                                                     | -A resilient doer of mathematics. (+ve) E                                                                  |
|                        | <p>‘...I understood everything from grade 1 until grade 2...’ (Spoken, 3)</p> <p>‘...I trained myself so that I can learn more so that I can solve more problems’ (Spoken, 6)</p> <p>‘...I trained myself to do those equations and I excelled’ (Spoken, 10)</p>                                                                                                                                                                                                | -A competent learner in FP. (+ve) EA                                                                       |
|                        | <p>‘...I also go to extra classes at school and also have a mathematics app on my phone that helps me to improve my results’ (Spoken, 17)</p>                                                                                                                                                                                                                                                                                                                   | - A lover of mathematics who has a mathematics App on his phone to help him improve his results. (+ve) E A |
|                        | <p>‘...I will never fail to overcome something that cannot talk...’ (Spoken, 9)</p>                                                                                                                                                                                                                                                                                                                                                                             | -A learner who believes that he will never fail to overcome something that cannot talk. (+ve) E I          |
|                        | <p>‘...I thought that maths was going to be hard...’ (Written, 8)</p>                                                                                                                                                                                                                                                                                                                                                                                           | -A learner who thought mathematics was going to difficult. (-ve) I                                         |



# APPENDIX T: Connecting MLIs to engagement and alignment

|                     |                                                                                                                                                                                                                                                                                                                                                    |                                                       |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| <b>Nkosi<br/>10</b> | <p>‘...I loved maths...’ (Spoken, 3)</p> <p>‘...I grew up I started to develop love for maths’ (Written, 4)</p> <p>‘...I enjoyed maths and I loved my maths teacher and that helped me to love maths too’ (Spoken, 1)</p>                                                                                                                          | - A lover of mathematics (+ve) I                      |
|                     | ‘I enjoyed maths because it challenged and pushed me to the limit’ (Written, 5)                                                                                                                                                                                                                                                                    | - A learner who enjoys mathematics (+ve) I E          |
|                     | <p>‘...I started practising maths every day because I wanted to solve (club coordinator’s) maths problem...’ (Written, 7)</p> <p>‘...I was so good in Maths that my previous school sent me around the town and province doing maths competitions’ (Written, 9)</p>                                                                                | -A competent learner (+ve) E                          |
|                     | <p>‘...I hated it because I was always told that maths is hard so I had that mindset (sic)’ (Written, 1)</p> <p>‘I stopped loving maths, I stopped having a positive attitude towards maths’ (Spoken, 5)</p> <p>‘I don’t like maths...’ (Spoken, 10)</p> <p>‘...I felt like maths was boring because I didn’t love it anymore...’ (Spoken, 10)</p> | -A hater of mathematics (-ve) I                       |
| <b>Esihle<br/>9</b> | ‘I loved the maths club...’ (Written, 7)                                                                                                                                                                                                                                                                                                           | -A lover of the after school mathematics club (+ve) I |
|                     | ‘...I compete with my friends and help each other with our maths problems’ (Written, 14)                                                                                                                                                                                                                                                           | -A learner who competes with friends (+ve) E          |
|                     | ‘...I was scared of high school...’ (Spoken, 8)                                                                                                                                                                                                                                                                                                    | -A learner fears high school mathematics (-ve) I      |
|                     | ‘...I understood maths because now I’m in grade 9 and I’m doing well...’ (Spoken, 8)                                                                                                                                                                                                                                                               | -A lover of mathematics (+ve) I                       |

# APPENDIX T: Connecting MLIs to engagement and alignment

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                               |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| <b>Khethiwe<br/>9</b> | <p>‘...I was struggling to do maths...’ (Written, 1)</p> <p>‘...I didn’t understand how to count the maths’ (Written, 2)</p> <p>‘I couldn’t understand the difference between the signs of multiplication, subtraction and adding’ (Written, 5)</p> <p>‘...I used to struggle because it was a little bit hard because it was my first time seeing x’s...’ (Written, 11)</p> <p>‘In grade 9 I struggled a lot...’ (Written, 18)</p>                                                                                                                                   | -A learner who struggles with mathematics (-ve) E A           |
|                       | <p>‘...I love maths more than maths lit...’ (Spoken, 8)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | -A lover of mathematics (+ve) I                               |
| <b>Lisa<br/>9</b>     | <p>‘...I was confused by Maths...’ (Written, 2)</p> <p>‘I couldn’t tell the difference between addition and subtraction...’ (Written, 3)</p> <p>‘...I would get low marks and I would (get) feel bad about myself’ (Written, 7)</p> <p>‘...I was shy, so I didn’t really do well in school’ (Spoken, 3)</p> <p>‘...I didn’t really understand the, what the teacher taught, the teachers’ style of teaching maths...’ (Spoken, 11)</p> <p>‘...I wasn’t really good at counting angles’ (Spoken, 10)</p> <p>‘...I was good but not that good at maths’ (Spoken, 5)</p> | -A learner who struggles with mathematics (-ve) E A           |
|                       | <p>‘I was good at maths...’ (Written, 9)</p> <p>‘...I received a certificate for improving in maths’ (Spoken, 2)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -An excellor at mathematics (-ve) A E                         |
|                       | <p>‘...I was good at maths there because I was comfortable in that school’ (Spoken, 8)</p> <p>‘...I was doing great in maths’ (Spoken, 9)</p>                                                                                                                                                                                                                                                                                                                                                                                                                         | -A lover of mathematics (+ve) I                               |
| <b>Funeka<br/>9</b>   | <p>‘When I started in the intermediate phase I was struggling again because maths was not the same we were working with big numbers...’ (Written, 5)</p> <p>‘...I was confused when it comes to be using the column when multiplying’ (Written, 5)</p>                                                                                                                                                                                                                                                                                                                | -A learner who struggles with mathematics at the IP (-ve) E A |

# APPENDIX T: Connecting MLIs to engagement and alignment

|                       |                                                                                                             |                                                          |
|-----------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
|                       | '...I will choose Pure maths in grade 10'<br>(Written, 15)                                                  | -A lover of mathematics (+ve)<br>I                       |
| <b>Lindelwa<br/>9</b> | 'At first I never liked maths it was the only<br>subject I hated' (Written, 2)                              | -A hater of mathematics (-ve)<br>I                       |
|                       | '...I was struggling with maths...' (Spoken,<br>1)                                                          | -A learner who struggles with<br>mathematics (-ve) E A   |
|                       | '...I loved maths more and more, it became<br>my favourite subject' (Written, 5)                            | -A lover of mathematics (+ve)<br>I                       |
|                       | '...I was getting certificates for maths<br>because I was one of the Top learners in<br>Maths' (Written, 6) | -An excellor at mathematics<br>(+ve) E A                 |
|                       | '...I appreciate everything that Maths Clubs<br>have done for me' (Written, 14)                             | -A lover of after school<br>mathematics club (+ve) I     |
|                       | '...in high school...I was scared I was so<br>scared' (Spoken, 7)                                           | - A learner who fears high<br>school mathematics (-ve) I |

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## **GLOSSARY OF ABBREVIATIONS & ACRONYMS**

**(in order of appearance)**

|        |                                                                            |
|--------|----------------------------------------------------------------------------|
| MLI    | Mathematics Learner Identity                                               |
| NCS    | National Curriculum Statement                                              |
| SACMEQ | Southern and Eastern African Consortium for Monitoring Educational Quality |
| DBE    | Department of Basic Education                                              |
| GET    | General Education and Training                                             |
| FET    | Further Education and Training                                             |
| FP     | Foundation Phase                                                           |
| IP     | Intermediate Phase                                                         |
| SP     | Senior Phase                                                               |
| HS     | High School                                                                |
| ECD    | Early Childhood Development                                                |
| UNESCO | United Nations Educational, Scientific and Cultural Organisation           |
| DHET   | Department of Higher Education and Training                                |
| SANCP  | South African Numeracy Chair Project                                       |
| CAPS   | Curriculum and Assessment Policy Statement                                 |
| STEM   | Science, Technology, Engineering and Mathematics                           |
| OECD   | Organisation for Economic Cooperation and Development                      |
| NCTM   | National Council for Teachers of Mathematics                               |
| PISA   | Programme for International Student Assessment                             |
| NCR    | National Research Council of the National Academies                        |
| UK     | United Kingdom                                                             |
| USA    | United States of America                                                   |
| ECDoE  | Eastern Cape Department of Education                                       |
| RUESC  | Rhodes University Ethical Standards Committee                              |
| ICT    | Information and Communications Technology                                  |
| TN     | Thematic Narrative Types                                                   |
| E      | Engagement                                                                 |
| A      | Alignment                                                                  |
| I      | Imagination                                                                |
| +ve    | positive                                                                   |
| -ve    | negative                                                                   |
| M.L.   | Mathematical Literacy                                                      |

