FACTORS AFFECTING COLLECTIVE MANAGEMENT PROCESS OF MATHEMATICS TEACHING AND LEARNING: A CASE FOR HIGHVELD RIDGE EAST CIRCUIT, MPUMALANGA

by

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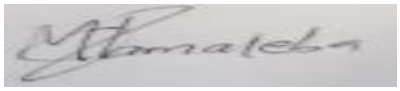
DECLARATION OF THE RESEARCHER

I, Mmbangiseni Muriel Ramaleba, Student no. 36218448, hereby declare that the dissertation, *Factors Affecting Collective Management Process of Mathematics Teaching and Learning: A case for Highveld Ridge East Circuit, Mpumalanga*, presented to obtain the degree Master of Education in Education Management at UNISA, is my own work and that no one has presented it before to any other institution of higher learning. All sources cited in my research study are displayed and acknowledged in the text, with a complete list of references.



RAMALEBA, MM

06 January 2023
DATE

DEDICATION

I dedicate this study to my family – my siblings, my children and grandchildren for their love, support and encouragement during some of the worst times I went through when doing this research study.

To the Lord Almighty, I say to him be the glory. Without His support, this project would not have been possible.

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ABSTRACT

This study aimed at examining factors that affect the collective management process of mathematics teaching and learning in the Highveld Ridge East Circuit of the Gert Sibande District, Mpumalanga, South Africa. The study intended to establish parental and social level, school level as well as system and policy level factors that influence the collective management process of mathematics teaching and learning of Grade 12 learners. In undertaking the study, the revised Bronfenbrenner's bioecological model of human development as well as the Taylor and Baker's theory of learning performance were used as guiding theoretical frameworks. These theories were sourced from literature and were used in this study to provide a lens for the analysis of data and interpreting results for this study. An interpretivist/constructivist research paradigm was adopted for this study to support a qualitative case study approach. Three schools were included in the case study research design and eight in-depth interviews with school principals, heads of department responsible for mathematics and selected parents of Grade 12 mathematics learners. One non-participant observation was also conducted at each sampled school. Policy document analysis was also conducted. Data were analysed through qualitative content analysis which helped to establish themes and sub-themes. The findings, presented and analysed in accordance with the themes and sub-themes, indicated that the factors that affect the collective management process of mathematics teaching and learning can be grouped into three broad categories. The first category is for those factors that emanate from families and societies, the second one comprises factors emanating from the school environment and thirdly, other factors emanate from system and policy environments. This study recommends that to improve mathematics teaching and learning, there should be close collaboration between parents, communities and school management teams. Furthermore, the study recommends large-scale quantitative survey studies to further clarify factors impacting the collective management process in mathematics teaching and learning.

KEY TERMS: collective management process; mathematics teaching and learning; poor performance; parental and social level factors; school level factors; system and policy level factors; in-depth interviews.

SESOTHO ABSTRACT

TS'ELISO

Boithuto bona bo reretsoe ho hlahloba lintlha tse amang tsamaiso e kopanetsoeng ea ho ruta le ho ithuta thuto ea lipalo Seterekeng sa Highveld Ridge East Seterekeng sa Gert Sibande, Mpumalanga, Afrika Boroa. Boithuto bo ne bo rerile ho theha boemo ba batsoali le sechabeng, boemo ba sekolo hammoho le lintlha tsa boemo ba tsamaiso le leano tse susumetsang tsamaiso e kopanetsoeng ea thuto ea lipalo le thuto ea baithuti ba Kereiti ea 12. Ha ho etsoa boithuto, ho ile ha sebelisoa mohlala o ntlafalitsoeng oa Bronfenbrenner oa bioecological oa nts'etsopele ea batho hammoho le khopolo ea Taylor le Baker ea ts'ebetso ea ho ithuta e le tataiso ea moralo oa thuto. Likhopolo tsena li nkiloe libukeng 'me li ile tsa sebelisoa phuputsong ena ho fana ka lense bakeng sa tlhahlobo ea lintlha le liphetho tsa tlhaloso ea phuputso ena. Ho ile ha amohelwa paradigm ya mofetoledi/ constructivist bakeng sa phuputso ena ho tshehetsa mokgwa wa boithuto ba maemo. Likolo tse tharo li kenyelelitsoe moralong oa lipatlisiso tsa mohlala le lipuisano tse tebileng tse robeli le baokameli ba likolo, lihlooho tsa mafapha a ikarabellang bakeng sa lipalo le batsoali ba khethiloeng ba liithuti tsa lipalo tsa Kereiti ea 12. Ho ile ha boela ha etsoa tlhokomeliso e le 'ngoe ea ba sa nkang karolo sekolong se seng le se seng sa mohlala. Ho ile ha boela ha etsoa tlhahlobo ea litokomane tsa maano. Lintlha li ile tsa hlahlobjoa ka tlhahlobo ea litaba tsa boleng tse thusitseng ho theha meralo le lihloohoana. Dikutollo, tse hlahisitsweng le ho hlahlojwa ho ya ka meralo le metheonyana, di bontshitse hore dintlha tse amang tsamaiso e kopanetsweng ya ho ruta le ho ithuta dipalo di ka hlophiswa ka dikarolo tse tharo tse pharalletseng. Mokhahlelo oa pele ke oa lintlha tse hlahang malapeng le lichabeng, oa bobeli o na le lintlha tse tsoang tikolohong ea sekolo, 'me ea boraro, lintlha tse ling li tsoa tikolohong ea tsamaiso le maano. Phuputso ena e khothalletsa hore ho ntlafatsa thuto le thuto ea lipalo, ho be le tšebelisano e haufi pakeng tsa batsoali, sechaba le lihlopha tsa tsamaiso ea likolo. Ho feta moo, phuputso e khothalletsa liphuputso tse kholo tsa lipalo ho tsoela pele ho hlakisa lintlha tse amang tsamaiso e kopanetsoeng ea thuto ea lipalo.

MELAO EA HLOOHO: ts'ebetso ea tsamaiso e kopanetsoeng; ho ruta le ho ithuta lipalo; ts'ebetso e mpe; lintlha tsa boemo ba batsoali le sechabeng; lintlha tsa boemo ba sekolo; maemo a tsamaiso le pholisi; lipuisano tse tebileng.

ISIZULU ABSTRACT

Lolu cwaningo luhlose ukuhlola izici ezithinta inqubo yokuphatha ngokuhlanganyela yokufundisa nokufunda izibalo e-Highveld Ridge East Circuit yesiFunda sase-Gert Sibande, eMpumalanga, eNingizimu Afrika. Ucwaningo luhlose ukusungula izinga labazali nelenhlalo, izinga lesikole kanye nezici zesistimu nenqubomgomo ezinomthelela ohlelweni lokuphatha ngokuhlanganyela lokufundisa nokufunda izibalo zabafundi beBanga le-12. Ekwenzeni ucwaningo, imodeli ye-Bronfenbrenner ye-bioecological ebuyekeziwe yokuthuthukiswa komuntu kanye nethiyori kaTaylor no-Baker yokusebenza kokufunda yasetshenziswa njengezinhlaka zetiyori eziqondisayo. Lezi zinkolelo-mbono zithathwe ezincwadini futhi zasetshenziswa kulolu cwaningo ukunikeza ilensi yokuhlaziywa kwedatha kanye nemiphumela yokutolika yalolu cwaningo. I-paradigm yocwaningo lokuhumusha/i-constructivist yamukelwa kulolu cwaningo ukuze yeseke indlela yocwaningo lwecala. Izikole ezintathu zafakwa ekwakhiweni kocwaningo lwecala kanye nezingxoxo ezijulile eziyisishiyagalombili nothishanhloko bezikole, izinhloko zeminyango ebhekele izibalo nabazali abakhethiwe babafundi bezibalo beBanga le-12. Ukuqaphela okukodwa okungahlanganyeli nakho kwenziwa esikoleni ngasinye esiyisampula. Ukuhlaziywa kwemibhalo yenqubomgomo nakho kwenziwa. Idatha yahlaziywa ngokuhlaziywa kokuqukethwe okuyikhwalithi okusize ekutholeni izingqikithi nezindikimba. Okutholakele, okwethulwa futhi kwahlaziywa ngokuhambisana nezindikimba nezindikimba, kubonise ukuthi izici ezithinta inqubo yokuphatha ngokuhlanganyela yokufundisa nokufunda izibalo zingahlukaniswa zibe izigaba ezintathu ezibanzi. Isigaba sokuqala esalezo zici eziphuma emindenini nasemiphakathini, esesibili sihlanganisa izici ezivela endaweni yesikole futhi okwesithathu, ezinye izici zivela ohlelweni nezindawo zenqubomgomo. Lolu cwaningo luncoma ukuthi ukuze kuthuthukiswe ukufundisa nokufunda kwezibalo, kufanele kube nokusebenzisana eduze phakathi kwabazali, imiphakathi kanye namathimba aphethe izikole. Ngaphezu kwalokho, ucwaningo luncoma izifundo zocwaningo lwezibalo ezinkulu ukuze kuqhutshekwe nokucacisa izici ezinomthelela ohlelweni lokuphatha oluhlangene ekufundiseni nasekufundeni izibalo.

IMIGOMO EYINGQONDO: inqubo yokuphatha ngokuhlanganyela; ukufundisa nokufunda izibalo; ukusebenza kabi; izici ezingeni labazali nezenhlalo; izici zezinga lesikole; izici zesistimu nezinga lenqubomgomo; izingxoxo ezijulile.

LIST OF ACRONYMS

CALP	Cognitive Academic Language Proficiency
CAPS	Curriculum and Assessment Policy Statements
CEDU	College of Education
DBE	Department of Basic Education
FET	Further Education and Training
GET	General Education and Training
LiEP	Language in Education Policy
LoLT	Language of Learning and Teaching
MPEDU	Mpumalanga Provincial Department of Education
NCS	National Curriculum Statement
NDoH	National Department of Health
NPPPR	Programme and Promotion Requirements of the National Curriculum Statement
REQV	Relative Education Qualification Value
SACE	South African Council of Educators
SADTU	South African Democratic Teachers' Union
SAQA	South African Qualifications Authority
SGB	School Governing Body
SMT	School Management Team
UNISA	University of South Africa

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CHAPTER 1: ORIENTATION

1.1 INTRODUCTION

Mathematics is one of the core subjects that offers opportunities for learners in post-secondary school learning and in the world of work (Amoo & Disu, 2012:1; Naidoo & Kapofu, 2020:1). As such, it is imperative that learners perform well in the subject if they are to succeed in their tertiary studies. In order for the process of mathematics teaching and learning to be effective, it is important to establish factors that affect the collective management process of mathematics teaching and learning, which contributes to poor performance of learners in schools. In South Africa, a poor performing or an underperforming school is defined as a school that fails to achieve a final matric pass rate of 60% and above (Louw, Bayat & Eigelaar-Meets, 2011:1; Bayat, Louw & Rena, 2014:41). The collective management process of mathematics teaching and learning is necessary, especially in the face of persistent poor performance of learners in South African school in general, but mainly for schools in townships (Masitsa, 2004:216; Mabena, Mokgosi & Ramapela, 2021:451).

The success of learners in mathematics depends largely on the collective management of the teaching and learning of the subject with active involvement of key school stakeholders. Oriakhogba (2019:2) explained that collective management means close collaboration between various interested stakeholders in order to achieve specific goals. However, to enhance such improved performance of learners in mathematics, it is crucial that all stakeholders, such as school principals, departmental heads responsible for mathematics as well as parents and caregivers, work together to identify factors that may affect the performance of learners in the subject. Schoenfeld (2005:8) observed that mathematics teaching and learning encompasses dissemination of complex knowledge, planning and decision making by educators, which all influence how learners understand the subject. Various factors influence such a process of dissemination and assimilation of the subject of mathematics between educators and learners (Ellerton & Clarkson, 1996:992).

Previous studies, which explored factors affecting collective management of mathematics teaching and learning, have revealed various factors that can be grouped into three categories, which are parental and social factors, school factors and system

and policy factors. Parental and social level factors emanate from the families and communities from which the learners come. According to Bayat *et al*. (2014:51), these family level factors include, amongst others, income levels, single/double parent status, low socio-economic status of parents and learners and low educational attainment of caregivers. School level factors are those factors that emanate from specific school conditions that affect all the learners at that specific school. These factors which include, amongst others, school leadership, management and organisation, overcrowding, truancy, late coming and absenteeism and shortage of teaching and learning materials (Masitsa, 2004:217), whereas system and policy level factors are those factors that emanate from broader socio-political conditions such as government policy, the general culture of the country, province, district and local school environment conditions. These factors include policy on language of learning and teaching (LoLT), grade promotion policy as well as the general state of education at specific levels and grades (Mji & Makgato, 2006:262).

Although the challenge of poor academic performance is generally pervasive across all schools in South Africa, rural and township secondary schools are the most affected (Bayat *et al.* 2014:52). Poor academic performance in township secondary schools, relative to urban and town secondary schools, has been attributed by Mlachila and Moeletsi (2019:5) to inadequate resources in township schools, limited capacity management, lower subject content knowledge of teachers and the political influence of teacher unions in the education system.

1.2 BACKGROUND AND ORIENTATION TO THE RESEARCH STUDY

Maxwell (2013:221) argued that for qualitative research inquiries, it is important to understand the context in which participants act and the influence of such context on the actions, behaviour and interpretation of events and phenomena by the participants. As such, qualitative researchers are interested with understanding how events, actions and meanings are shaped by the unique circumstances in which they occur. The essence of this background is to outline the context in which teaching, learning and therefore performance of learners occurs, not only in the Highveld Ridge East Circuit of the Gert Sibande District in Mpumalanga Province, but also in the context of the rest of South Africa. This context encompasses broader constitutional aspirations of post-

apartheid South Africa, as well as the current status of mathematics teaching and learning.

One of the founding values of the Constitution of South Africa is to achieve human dignity, equality and advancement of human rights and freedoms. The Bill of Rights of the Constitution, Chapter 2, Section 29:

> *"1. Everyone has the right—*
> *(a) to a basic education, including adult basic education; and*
> *(b) to further education, which the state, through reasonable measures, must make progressively available and accessible.*
>
> *2. Everyone has the right to receive education in the official language or languages of their choice in public educational institutions where that education is reasonably practicable. In order to ensure the effective access to, and implementation of, this right, the state must consider all reasonable educational alternatives, including single medium institutions, taking into account—*
> *(a) equity;*
> *(b) practicability; and*
> *(c) the need to redress the results of past racially discriminatory laws and practices."*

According the citation above, everyone in South Africa is entitled to the right to both basic and further education, with the state being obliged to make such education reasonably accessible and available to all citizens, regardless of gender, tribe, race and other circumstances that may be present in South African societies. This right to education has been predicated on the desire to achieve just and equitable society, redress past imbalances, improve the quality of life of all citizens as well as to nurture the potential of each individual (Government of South Africa, 1996a:2,3,12). These aspirations as enshrined in the Constitution, but are more relevant and pertinent in the context of previously disadvantaged societies such as townships and rural areas where this study was conducted.

The responsibility for national policy governance of basic education in South Africa rests with the national Department of Basic Education (DBE) under the administration

of the national minister of basic education, as appointed by the President (Government of South Africa, 1996c:4). Currently the minister responsible for the national Department of Basic Education is Mrs Angie Motshekga, MP. In South Africa, basic education encompasses foundation, primary and secondary education. This spectrum of basic education is further categorised into phases/bands which are: foundation phase covering Grades R – 3; intermediate phase covering Grades 4 – 6, the senior phase covering Grades 7 – 9. The foundation, intermediate and senior phases (Grades R – 9) are collectively known as General Education and Training (GET) band. Grades 10 – 12 are covered separately in what is known as the Further Education and Training (FET) band (DBE, 2015:3).

Since 2012, curriculum issues guiding learning and teaching in South Africa for all grades under basic education were consolidated under one policy statement called the National Curriculum Statement Grades R – 12. This curriculum policy statement broadly covers three aspects of teaching and learning which are the subject syllabuses known as Curriculum and Assessment Policy Statements (CAPS) for all approved subjects, the National Policy pertaining to the Programme and Promotion Requirements of the National Curriculum Statement Grades R – 12 as well as the National Protocol for Assessment Grades R – 12 (DBE, 2014:3). Additionally, the National Curriculum Statement Grades R – 12 stipulates the broad and general aims of the South African national curriculum. These broad aims include equipping learners from various socio-economic backgrounds - such as race, gender, physical ability or intellectual ability - with appropriate knowledge, skills and values necessary for self-fulfilment and meaningful participation in society; providing access to higher education as well as facilitating the transition of learners from educational institutions to the workplace and employment (DBE, 2014:9). Mathematics plays a pivotal role in developing the skills required to fulfil the broad aims stipulated in the National Curriculum Statement Grades R – 12, since it is an essential requirement for learners to pursue careers that are crucial for economic growth and development (Naidoo & Kapofu, 2020:1).

In presenting the 2019 National Senior Certificate Schools Subject Report, the Minister of Basic Education, Honourable A.M. Motshekga highlighted that one of the key measures of assessing performance in school subjects is through the National Senior

Certificate (NSC) results written by Grade 12 learners. In terms of Action Plan of the Department of Basic Education, one of the key targets which is measured through performance in the National Senior Certificate is the increase in the number of Grade 12 learners who pass mathematics as well as the increase in the number of Grade 12 learners who pass Physical Science (DBE, 2020a:2).

This study is closely related to one of the key targets measured through performance in the National Senior Certificate which is the increase in the number of Grade 12 learners who pass mathematics. Specifically, this study intended to explore factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor academic performance of Grade 12 learners in mathematics in the Highveld Ridge East Circuit of the Gert Sibande District, Mpumalanga, South Africa. In this study, poor academic performance means achieving a pass rate of below 60%, as posited by Louw *et al.* (2011:1) and Bayat *et al.* (2014:41). Summarised in Table 1.1 are the overall national and provincial statistics on learner performance in mathematics for the four-year period 2016 to 2019.

Table 1.1: National and provincial statistics on learner performance in mathematics for the period 2016 to 2019

	2017			2018			2019		
	Number of students Who wrote Mathematics	Number of students Who passed with 30%+	Percentage pass rate	Number of students Who wrote Mathematics	Number of students Who passed with 30%+	Percentage pass rate	Number of students Who wrote Mathematics	Number of students Who passed with 30%+	Percentage pass rate
National	245 103	127 197	51.9%	233 858	135 638	58.0%	222 034	121 179	54.6%
Mpumalanga Province	24 327	11 628	47.8%	24 207	13 120	54.2%	22 621	11 672	51.6%
Gert Sibande District	5 481	3 031	55.3%	5 886	3 473	59.0%	5 490	3 096	56.4%

(Sources: DBE, 2018, 2019; 2020b)

Table 1.1 above shows that for the three-year period from 2017 to 2019, the mathematics pass rate nationally and in Mpumalanga, was persistently below 60%, signifying poor academic performance in mathematics not only for learners in

Mpumalanga but learners across the country. In 2017, 245 103 learners sat for mathematics examination countrywide and 24 327 learners in Mpumalanga but only 127 197 learners passed nationally representing a pass rate of 51.9% with 11 628 learners passing in Mpumalanga, representing a pass rate of 47.8%.

A similar pattern was observed in 2018 when 233 858 learners wrote mathematics countrywide and only 135 638 passed representing a national pass rate of 58.0%. Provincially in 2018, Mpumalanga had 24 207 learners who sat for mathematics out of which only 13 120 passed representing a provincial pass rate of 54.2%. In 2019, nationally 222 034 learners sat for mathematics of which 121 179 passed representing a national pass rate of 54.6%. In Mpumalanga 22 621 learners wrote mathematics in 2019 but only 11 672 passed representing a provincial pass rate of 51.6%.

In the Gert Sibande District, the mathematics pass rate was also persistently below 60% during the same period from 2017 to 2019. In 2017, 5 481 learners wrote mathematics but only 3 031 passed, representing a district pass rate of 55.3% whereas in 2018, 5 886 learners sat for the mathematics examination with only 3 473 passing, representing a district pass rate of 59.0%. A similar pattern was obtained in 2019 examinations when 5 490 learners sat for mathematics with only 3 096 passing, which was a pass rate of 56.4%. The national, provincial and district mathematics results for the three years from 2017 to 2019 provides the current status of poor performance of learners in mathematics for the study under review.

The Highveld East Circuit is located in the Gert Sibande District in Mpumalanga and consists of primary and secondary schools, which are located in both townships and in town centres. I have been an educator in one township secondary school in the Highveld East Circuit for more than 15 years in the Further Education and Training (FET) band and in most of the years, teaching Mathematical Literacy in Grade 12. Over the years our school has consistently performed poorly in Pure Mathematics affecting the prospects of our learners in advancing their opportunities post matric. This study was motivated by the desire to establish a set of factors that affect the collective management process of mathematics teaching and learning and hence influence performance of learners in mathematics in secondary schools in the Highveld East Circuit with a view of offering practical recommendations to relevant stakeholders so that the challenge of poor performance in mathematics can be

collectively managed by all stakeholders such as parents, teachers and school management teams.

1.3 LITERATURE OVERVIEW

In this subsection, a brief overview of literature relating to studies in mathematics teaching, learning and performance was provided. Generally, the studies were grouped based on the main categories established in the introduction which are parental and social level factors, school level factors and system and policy level factors. These studies were conducted in various geographical places with varying methodologies.

The critical importance of mathematics as a subject has resulted in heightened interest of inquiry by several scholars. Several strands of scholarly inquiries were undertaken and one such strand investigated learner performance in mathematics in secondary schools across South Africa. Several studies in this strand focused on factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor learner performance in mathematics in secondary schools with special emphasis on rural and township secondary schools located in previously disadvantaged communities, which were affected by the legacy of Bantu Education. The summary of studies that explored factors affecting collective management process of mathematics teaching and learning is provided on the concept matrix presented on Table 1.2 below.

Table 1.2: Concept matrix for previous studies in mathematics

Study	Geographical Region	Perspectives on Participants	Methods
Mji & Makgato (2006)	Tshwane North District 3, Gauteng	Mathematics teachers and leaners	Non-experimental, exploratory and descriptive study Semi-structured interviews Focus group interviews
Makgato (2007)	Soshanguve, Gauteng	Mathematics teachers and learners	Non-experimental, exploratory and descriptive study Unstructured interviews
Alt et al. (2014)	Tucson, Arizona, USA	School-aged mathematics learners	Experimental comparative
Sinyosi (2015)	Nzhelele East Circuit, Limpopo	Mathematics teachers, learners and SMT members	Case study Semi-structured interviews

Study	Geographical Region	Perspectives on Participants	Methods
			Focus group interviews
Dhurumraj & Heeralal (2016)	Pine Town District, KZN	Mathematics teachers and learners	Case study Interviews Observations
Gniewosz & Watt (2017)	Australia	Mathematics learners	Quantitative longitudinal study and regression analysis
Letsoalo (2017)	Sekgosese Cluster, Limpopo	Mathematics learners	Quantitative survey and descriptive statistics questionnaire
George & Adu (2018)	King William's Town, Eastern Cape	Mathematics learners	Quantitative survey and descriptive statistics Questionnaire
Rankhumise (2018)	Motheo District, Bloemfontein, Free State	Mathematics teachers and learners	Mixed method design Quantitative survey and descriptive statistics Qualitative semi-structured interviews
Makofane & Maile (2019)	Bohlabela Cluster, Limpopo	Mathematics teachers, learners, departmental heads, principals and curriculum advisor	Case study design Semi-structured interviews Observations
Naidoo & Kapofu (2020)	Ulwazi High School, KwaZulu-Natal	Mathematics learners	Case study Focus group interviews
Ajimudin (2021)	Francis Baard District, Free State	Mathematics teachers & learners	Case study design Semi-structured interviews with teachers Focus group interviews with learners
Mabena, Mokgosi & Ramapela (2021)	Kwagga West Circuit, Nkangala, Mpumalanga	SMT members, teachers, learners and parents	Case study design Semi-structured interviews Observations
Moleko (2021)	Free State	Mathematics teachers	Case study design Focus group discussions
Graham, Mokgwathi & De Villiers (2021)	Whole of South Africa	Principals and mathematics teacher	Explanatory sequential mixed method design Multiple case studies Semi-structured interviews TIMSS 2019 data Inferential statistics
Wawan & Retnawati (2022)	Indonesia	Mathematics learners	Quantitative survey and regression analysis Questionnaire
Gabina et al (2022)	Ghana	Mathematics learners and tutors	Quantitative survey and descriptive statistics Questionnaire
Wardat et al (2022)	Emirite of Abhu Dhabi, UAE	Mathematics learners	Quantitative survey and regression analysis Questionnaire

(Source: Own construction from literature studies)

Several factors were identified by different scholars as causes of poor learner performance in mathematics. These factors include learners' family background (Heeralal & Dhurmraj, 2016:310), socio-economic background of learners such as income levels (Rankhumise, 2018:99), parental involvement in the education of their children (Mji & Makgato, 2006:261), mathematics literacy levels of parents and caregivers (Sinyosi, 2015:51-52; Letsoalo, 2017:9502) as well as the perceptions of learners for the subject of mathematics (Naidoo & Kapofu, 2020:1). Other factors that were identified were related to school specific factors such as non-completion of syllabus (Mji & Makgato, 2006:261), poor subject content knowledge and delivery by mathematics teachers as well as limited contact time for mathematics teaching and learning (Makofane & Maile, 2019:43-45), insufficient instructional leadership to mathematics teachers by School Management Teams (SMTs) (Sinyosi, 2015:67), large and overcrowded classes (Heeralal & Dhurumraj, 2016:304;315; Rankhumise, 2018:99), and lack of adequate resources such as textbooks and libraries (Mlachila & Moeletsi, 2019:37).

Other scholars identified factors that are influenced by the broader education system and policies in South Africa. These factors include the language of learning and teaching (LoLT) (Makgato, 2007:99-100), lack of proper foundation at primary school level (Rankhumise, 2018:99); inappropriate grade promotion policy (Rankhumise, 2018:99); the quality of teachers' experience and qualifications; teacher subject content knowledge (Sinyosi, 2015:68) and militancy and influence of trade unions (Roodt, 2018:7).

In terms of geographical spread, the studies were widely distributed. For example, globally, the studies were conducted by Alt et al (2014) in Tucson, Arizona, United States of America; Gniewosz and Watt (2017) in Australia; Wawan and Retnawati (2022) in Indonesia; Wardat et al (2021) in Abhu Dhabi, United Arab Emitires; and Gabina *et al*. (2022) in Ghana. In South Africa studies were also widely spread across various provinces and districts conducted by Graham *et al*. (2021) in the rest of South Africa; Mji and Makgato (2006) in Tshwane District 3, Gauteng; Makgato (2007) in Soshanguve, Gauteng; Sinyosi (2015) in Nzhelele East, Limpopo; Letsoalo (2017) in Sekgosese, Limpopo; Makofane and Maile (2019) in Bohlabela Cluster, Limpopo; Dhurumraj and Heeralal (2016) in Pinetown District, KwaZulu-Nata; Naidoo and

Kapofu (2020) in Umlazi, KwaZulu-Natal; Rankhumise (2018) in Motheo District, Free State; Ajimudin (2021) in Franci Baard District, Free State; Moleko (2021) in Free State; George and Adu (2018) in King William's Town, Eastern Cape; and Mabena et al (2021) in Nkangala, Mpumalanga.

The studies used different research designs and methods from quantitative surveys using questionnaires as data collection instruments and descriptive statistics (Letsoalo, 2017; George and Adu, 2018; Gabina et al., 2022); quantitative survey and regression analysis (Wardat *et al.,* 2022); quantitative longitudinal study and regression analysis (Gniewosz & Watt, 2017); non-experimental, exploratory and descriptive study with semi-structured and unstructured interviews and focus group interviews (Mji & Makgato, 20066; Makgato, 2007); case study and interviews, observations and focus group interviews (Sinyosi, 2015; Dhurumraj & Heeralal, 2016; Makofane & Maile, 2019; Naidoo & Kapofu, 2020; Ajimudin, 2021; Mabena et al., 2021; Moleko, 2021; experimental comparative study (Alt *et al.,* 2014); mixed methods study with a combination of quantitative survey, descriptive statistics and interviews (Rankhumise, 2018); mixed methods study with a combination of interviews, secondary data and inferential statistics (Graham *et al.,* 2021).

Thirdly, the studies solicited perspectives from different sets of participants including mathematics teachers, learners, SMT member, departmental heads, principals and parents as mathematics learners only (Alt *et al.,* 2014; Gniewosz & Watt, 2017; Letsoalo, 2017; George & Adu, 2018; Naidoo & Kapofu, 2020; Wawan & Retnawati, 2022; Wardat *et al.,* 2022); mathematics teachers only (Moleko, 2021); mathematics teachers and learners (Mji & Makgato, 2006; Makgato, 2007; Dhurumraj & Heeralal, 2016; Rankhumise, 2018; Ajimudin, 2021; Gabina et al., 2022); principals and mathematics teachers (Graham *et al.,* 2022); mathematics teachers, learners and SMT members/departmental heads (Sinyosi, 2015); mathematics teachers, learners, departmental heads, principals and curriculum advisor (Makofane & Maile, 2019); mathematics teachers, learners, SMT members/departmental heads and parents (Mabena *et al.,* 2022).

Finally, the brief review of literature in the field of factors contributing to poor academic performance of learners in mathematics has revealed that the factors that were identified by scholars can generally be classified in three broad categories which are

parental and social level factors, school level factors as well as system and policy factors. These studies were widely distributed geographically among all the provinces of South Africa and their methodologies differ from one study to the other. Finally, these studies sought perspectives from different sets of participants who include mathematics teachers, learners, SMT members/departmental heads, principals, parents and curriculum advisors.

1.4 THEORETICAL FRAMEWORK

A theoretical framework is defined by Adom, Hussein and Agyem (2018:438) as a blueprint that a researcher adopts to build his/her own research inquiry which serves as a foundation upon which the research inquiry is built. Creswell and Creswell (2018:322) further asserted that a theoretical framework lays down a set of assumptions to guide the design and conduct of research inquiry. This study intended to investigate factors that affect the collective management process of mathematics teaching and learning and hence causing poor learner performance in mathematics for learners in secondary schools in the Highveld Ridge East Circuit. The performance of learners in mathematics has been subject of intense academic inquiry not only in South Africa but in many other countries across the world.

This study was guided by two theories which are Taylor and Baker's (2006) theory of learning performance as well as the revised Bronfenbrenner's bioecological model of human development (1979, 2006). The Taylor and Baker (2006) theory of learning performance concentrated on the social environment as well as the academic environment as they affect teaching and learning of mathematics. However, emphasis was placed on the academic environment which encompass school level factors which influence learning performance in schools. Major elements outlined under the academic environment are instructors, methods, materials and peers. In the societal environment, issues such as family, community and cultural influences. All these academic and societal environmental elements affect the way in which mathematics is being taught and leant in classrooms. Furthermore, they also affect the motivation and efforts of learners which affect learning performance. Although the Taylor and Baker (1996) theory of learning performance has clarified school level factors, it has not provided much clarity on parental and social level factors as well as systems and policy level factors. As a result, it was believed that another theory which clarifies these

two should be included and hence the adoption of the revised Bronfenbrenner (1979, 2006) bioecological model of human development.

The revised Bronfenbrenner (1979, 2006) bioecological model of human development emphasises on four elements as they relate to human development and these are proximal processes which define complex and sustained interactions between the person and the different environments, the attributes of the developing person, the influences of time as well as the contexts in which everything happens. The proximal processes and the person provide guidance mainly on parental and social level factors, whereas the contexts, mainly the exosystem, provides guidance on system and policy level factors where the developing person (learner) is not a direct player but is affected by actions and decisions in that sphere.

These two theories complimented one another with the Taylor and Baker (2006) theory of learning performance guiding school level factors whereas the revised Bronfenbrenner (1979, 2006) bioecological model of human development guiding parental and social level factors as well as system and policy level factors.

1.5 DEFINITION OF KEY TERMS

The key terms to be used throughout these studies are defined below:

1.5.1 Collective Management

Collective management can generally be defined as the collaboration between different interested stakeholders to monitor, manage and address common interests to promote transparency, accountability and efficiency (Oriakhogba, 2019:2). In this study, the interested stakeholders are parents, educators, school management teams (SMTs) and school governing bodies (SGBs). Their common interest is performance of Grade 12 learners in mathematics in public schools.

1.5.2 Mathematics Teaching and Learning

Schoenfeld (2005:8) characterised mathematics teaching and learning as unravelling complexities of teaching mathematics which include complex knowledge, planning and decision-making that educators engage in and which influence the way learners understand the subject of mathematics. Ellerton and Clarkson (1996:992) elaborated that there are several factors that interplay in such complexities and thus influence the

way mathematics is taught by educators and learnt by learners. In this study, such factors were identified to emanate from families and societies (Mji & Makgato, 2006:261; Sinyosi, 2015:27; Heeralal & Dhurumraj, 2016:309) school environment (Bayat *et al.*, 2014:50; Heeralal & Dhurumraj, 2016:312; Rankhumise, 2018:99; Mlachila & Moeletsi, 2019:37) and the system and policy level environment (Louw *et al.,* 2011:58; Sinyosi, 2015:49). These are the factors that are believed to impact significantly on collective management process of mathematics teaching and learning in schools in South Africa.

1.6 PROBLEM STATEMENT

Poor performance of Grade 12 learners in the mathematics final examinations over the years has been a persistent problem in South Africa, despite several policy interventions by the government and efforts by parents, educators and school management. According to the Department of Basic Education (DBE, 2019:5), the national mathematics pass rates have persistently fallen below 60% over the five-year period from 2015 to 2019 as 49.1% in 2015 and 51.1%, 51.9%, 58% and 54.6% for the years 2016, 2017, 2018 and 2019 respectively in that order. The problem is even more pronounced for learners in secondary schools in township and rural schools. Most secondary schools, located in the Highveld Ridge East Circuit are located in the townships of Embalenhle, Leandra and Kinross, have been underperforming in mathematics in the five-year period from 2015 to 2019.

As a result of the general poor performance of mathematics around the world and in South Africa, a number of studies have been undertaken to explore factors that affect teaching and learning of the subject. As highlighted earlier under literature overview, generally studies made findings which can be classified into three major categories which are parental and family level factors, school level factors as well as system and policy level factors. However, these studies were conducted in different geographical areas using different research designs and methods as well as taking perspectives of different stakeholders in the teaching and learning of mathematics. Although a number of studies were conducted in South Africa to examine factors affecting mathematics teaching and learning, few studies focused on Mpumalanga, South Africa and more specifically on the Gert Sibande District which is predominantly a rural and township district in a mining area. Secondly, fewer studies have focused on the perspectives of

the collective management process of mathematics teaching and learning by seeking views of key interested stakeholders in mathematics teaching and learning who are principals, departmental heads and parents. This study intends to fill in that knowledge gap.

Hence this study examined factors that affect the collective management process of mathematics teaching and learning and hence causing such persistently poor performance in mathematics in those schools and from such factors to provide recommendations to parents, school management teams (SMTs) and school governing authorities (SGBs). These recommendations that might be useful for the collective management process of mathematics teaching and learning in secondary schools in Highveld Ridge East Circuit in Mpumalanga.

1.7 RESEARCH QUESTIONS

In light of the problem, this research intended to answer the following main question: *What factors affect the collective management process of mathematics teaching and learning in the Highveld Ridge East Circuit in the Gert Sibande Region of Mpumalanga, South Africa?*

In order to answer the main research question, the following sub-questions have been formulated:

1. What parental and social level factors affect the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?
2. Which school level factors influence the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?
3. How do system and policy level factors affect the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?
4. How does technology impact on the collective management process of mathematics teaching and learning and performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?

1.8 AIM AND OBJECTIVES

The broad aim of this study was to determine factors that affect the collective management process of mathematics teaching and learning of mathematics for Grade 12 learners in the Highveld Ridge East Circuit of the Gert Sibande Region, Mpumalanga, South Africa.

In order to achieve the aim of this study, the following objectives were pursued:

1 To explore parental and social level factors that impact the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit.
2 To establish school level factors that influence the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit.
3 To discover how system and policy level factors affect the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit.
4 To explore how technology affects collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit.

1.9 RESEARCH METHODOLOGY

Research methodology is defined by Saunders, Lewis and Thornhill (2019:4) as the way or process in which one collects and analyses data. In other words, methodology refers to a design whereby the researcher selects data collection and analysis procedures to investigate a specific research problem. Saunders et al (2019:4) summarised research methodology as the theory of undertaking research. The following subsections highlight the methodology steps adopted for this study.

1.9.1 Research Paradigm

A research paradigm can generally be defined as a knowledge claim, a philosophical assumption or a set of beliefs that shape the execution of research (Creswell, 2014:4). There are broadly three research paradigms or philosophies which relate to research.

Post-positivism (objectivism) embraced in natural sciences, entails the belief that the social reality that is studied in research is external and there is one set of reality. Constructivism (subjectivism) is embraced in arts and humanities and entails the belief that social reality is shaped by perceptions and subsequent actions of the social actors. Pragmatism holds the belief that the way to view social reality and the way research is done is influenced by the objectives of the research and the research questions (Saunders *et al.,* 2019:134-137). This study followed an interpretivist or constructivist research paradigm which maintains that in any scenario, there are multiple socially constructed realities (McMillan & Schumacher, 2014:14).

1.9.2 Research Approach

Creswell and Creswell (2018:1) define a research approach as a plan and the procedures for conducting a research inquiry spanning the steps covering broad assumptions to detailed methods of data collection, analysis and interpretation. In other words, a research approach is situated in the intersection of philosophy, research designs, and specific methods. There are broadly three research approaches that are applied in research which are qualitative, quantitative and mixed methods approaches (Cohen, Manion & Morrison, 2018:31).

The major orientation of a quantitative research approach centres on establishing a single reality measured by an instrument and also to establish relationships among measured variables, whereas a qualitative research approach aims at establishing multiple socially constructed realities by understanding the settings of the participants and their perspectives. A mixed method approach combines the two orientations (McMillan & Schumacher, 2014:20).

This research study followed a qualitative research approach which emphasises gathering and analysing data on naturally occurring phenomena and as such, data were mainly in the form of words rather numbers (McMillan & Schumacher, 2014:31). This approach was considered suitable for this study since the research aimed at understanding factors that affect the collective management process of mathematics teaching and learning from the view of participants in their own situations at schools, homes and communities.

1.9.3 Research Design

Research design is defined by McMillan and Schumacher (2014:6) as the general plan of how the research is conducted, including the description of subjects and methods of data collection that can be employed in a research study. The purpose of a research design is to specify a plan for generating empirical evidence that can be used to address the research questions. This study's design was a multisite case study focusing on three schools in the Highveld Ridge East Circuit.

A case study was chosen because it allowed the researcher to use various sources of data and data collection methods to examine a bounded system, or a case, over time and in depth (McMillan & Schumacher, 2014:6). Gomm, Hammersley and Foster (2009:2) explain a case as a microcosm of a large system or of a whole society and as such, what is found in a case is reflective of what is a happening more generally in the broader system. Case studies are often employed in explanatory and exploratory studies into which this study falls. As such, a case study was believed to be the most appropriate design to establish factors affecting the collective management process of mathematics teaching and learning in the Highveld Ridge East Circuit in the Gert Sibande District, Mpumalanga, South Africa.

1.9.4 Research Methods

Creswell and Creswell (2018:17) explain that research methods outline forms of data collection, analysis and interpretation that a researcher employs in a research study. Since this study falls under a qualitative research approach, a variety of data collection techniques were used to gain an understanding of underlying opinions, reasons and problems as identified by participants who could offer insight into the problem under investigation.

1.9.4.1 Population of the study

The target population of this study comprised all secondary schools in the Highveld Ridge East Circuit of the Gert Sibande District, Mpumalanga, South Africa.

1.9.4.2 Sampling technique

The sampling technique adopted was based on the definition of underperformance in South African schools. According Louw *et al.* (2011:1) and Bayat *et al.* (2014:41) underperformance can be defined as achieving a pass rate below 60%. The sampling technique that was applied in this study was based on that guideline and related specifically to all schools in the Highveld Ridge East Circuit that obtained a mathematics pass rate of 60% or below in at least three of the five consecutive years from 2015 to 2019. Using this criteria, three schools were selected from the population.

Participants were principals and departmental heads responsible for mathematics from the three schools, as well as three selected parents of Grade 12 mathematics learners, one from each school in the case study. These participants were selected using purposive sampling techniques in which participants are selected based on their possession of certain characteristics or quality (Cohen *et al.,* 2018:214). These participants were chosen based on their possession of knowledge of factors impacting the collective management process of mathematics teaching and learning.

1.9.4.3 Data collection

A researcher can use an instrument or test such as questionnaire or interview question sheet to collect data or can gather information by observing behaviour of participants through observations (Creswell & Creswell, 2018:17). Several data collection techniques can be applied in a case study, largely in combination, and these techniques include questionnaires, interviews, observations, artefacts and document analysis (Saunders *et al.,* 2009:146; McMillan & Schumacher, 2010:342). The study employed in-depth interviews, observations and document analysis to collect data from participants and classrooms at the three schools in the case.

(i) In-depth interviews

The study employed semi-structured and in-depth interviews. In-depth face-to-face interviews are used to collect data from participants using open-response questions which give the researcher the opportunity to drill deep by asking follow-up questions for clarifications (McMillan & Schumacher, 2010:350-7). A total of nine in-depth interviews were planned but eventually eight were conducted. From each school in the sample, in-depth face-to-face interviews were conducted with the principal, one member of the School Management Team (SMT) preferably the departmental head

responsible for mathematics, as well as one parent who was a member of the School Governing Body (SGB).

(ii) Non-participant observations

This study adopted non-participant observations in order to enable the researcher to gather first-hand information about the atmosphere, ambience, interactions as well as other non-verbal cues that could not be condensed by mere writing or speaking. Observations are qualitative and emphasise discovering the meanings that people attach to their actions (Saunders *et al.,* 2009:288). Three non-participant observations, one at each school, were planned and conducted in this study.

(iii) Document analysis

Policy document analysis was employed in this study to evaluate government policies on language of learning and teaching (LoLT), appointment of mathematics teachers, learner absenteeism, teacher absenteeism as well as assessment and planning, as outlined in the Curriculum Assessment and Policy Statement (CAPS). The documents that were analysed included the Acts of Parliament and national policies related to education in South Africa. The main advantage of document analysis is that there is little interaction between the researcher and the participants or subjects (McMillan & Schumacher, 2010:361).

1.9.4.3 Data analysis

McMillan and Schumacher (2014:397) stated that qualitative data is collected and recorded mainly in three forms, which are notes taken during observation and interviews, audiotape-recorded interviews as well as visual images and videos recorded in observations and interviews. The data collected is transformed into a format that allows for further manipulation and analysis. Qualitative content analysis was used as the data analysis method in this study and consists of a technique for coding and categorising voice, textual, visual data in a systematic way so as to establish patterns in the data (Saunders *et al.,* 2019:573). The steps in qualitative content analysis are briefly described below.

(i) Data transcription

In this study, interviews were audiotape-recorded and notes were taken, whereas observations were recorded in the form of notes taken in the classrooms observed

and recorded on pre-prepared observation protocols. Documents were analysed and recorded in the form of notes derived from studying the documents as obtained from various laws and national policies downloaded from the website of the National Department of Basic Education. Audiotape recorded interview conversations were transcribed in written verbatim transcripts in MS Word format after conclusion of each interview.

(ii) Data coding

Stake (2010:151) described coding as sorting of data sets according to main topics, themes, and issues important to the study. This sorting of data can be formulated based on research questions, concept maps, or clusters of patches developing. Data responses were aggregated and sorted according to main themes along parental and social factors, school level factors and system level factors so as to gain deeper understanding of the main themes. The main themes and concepts centre on parental and social level factors, school-based factors as well as system and policy-induced factors that affect the collective management process of mathematics teaching and learning and hence impact on learner performance in mathematics.

1.10 TRUSTWORTHINESS

In essence, trustworthiness can be thought of as the ways in which qualitative researchers ensure that their studies produce results which are a truthful representation of what the studies intended to explore. This attribute ensures that study results can be transferable, credible, dependable, valid and reliable (McMillan & Schumacher, 2010:102).

1.10.1 Credibility

Saunders *et al*. (2009:156) posited that the aspect of credibility needs to minimise the possibility of a study producing wrong answers to research questions. Lune and Berg (2017:196) advised that in order to ensure credibility in research, the researcher needs to explain the methods used in a study and in addition, follow those methods clearly and precisely so that peers and readers would trust the outcomes of the research process. Credibility can be assured by various methods such as triangulation of different information sources, member checking, rich and thick description of methods, inter-coder agreement, resolution of disconfirming evidence as well as academic

advisor's auditing (Creswell & Clark, 2018:432). Accordingly, credibility of this research was ensured by triangulation of data from interviews, observations and documents analysed, providing rich and thick description of the whole research process mainly methodology, data collection and results, as well as consistent guidance by the supervisor.

1.10.2 Dependability or reliability

Stake (2010:118) explained that for a study to be dependable, researchers should prepare evidence and ensure the understanding for users of research, the practitioners and administrators and policy makers. As such, users of research studies should act with caution and wait for confidence in the dependability of research studies. In order to ensure dependability in this study, all the interview questions were sent to two independent peers to ascertain whether they address the research objectives of the study.

1.10.3 Confirmability

The research findings should be able to be confirmed to the extent that a different researcher, repeating the study under similar conditions, methods and participants, should also obtain similar results. This quality is also referred to as verifiability (McMillan & Schumacher, 2010:9) and was ensured by adopting research instruments that have been consistently applied by scholars in the field of poor performance in mathematics in South Africa. All the responses gathered in the face-to-face interviews were audiotape recorded and transferred into verbatim transcriptions that were kept safe.

1.10.4 Transferability

McMillan and Schumacher (2014:15) describes transferability as a quality of research study that enables the reader to apply information obtained from the study to other settings and circumstances. This attribute can be enhanced by providing a detailed description of all the steps involved in the research study so that readers can identify shared characteristics. This aspect of transferability implies that the methods, instruments, results and findings from a study can be used or inferred in different contexts. The aspect of transferability in this study was enhanced by logically laying out the research process as well as a description of the phenomenon under research.

1.11 ETHICAL MEASURES

In conducting research studies, it is the responsibility of the researcher to ensure that the research is conducted with integrity in an ethical and honest manner and also to avoid academic fraud which might occur (Mertens, 2015:61). Several issues therefore need to be considered and ensured in carrying out research and these include ensuring informed consent, voluntary participation, confidentiality, anonymity and avoiding harm or risk to participants (Adams, Khan & Raeside, 2014:21). These issues are discussed in the following subsections.

1.11.1 Gaining permission to conduct study

Cohen *et al.* (2018:124) states that it is an ethical obligation for the researcher to seek permission from gatekeepers to conduct research study within the premises they control. As a result, before this study was conducted, permission to conduct the study within the selected schools was applied from the Mpumalanga Provincial Department of Education, the Gert Sibande District Department of Education as well as the Highveld Ridge East Circuit.

1.11.2 Informed Consent

The ethical requirement for informed consent stipulates that subjects or participants should agree to participate in the research with full knowledge of the aims and purposes of the study (McMillan & Schumacher, 2014:130). Stake (2010:204) went even further to suggest that qualitative researchers should not only obtain informed consent but that such consenting should be anonymised as well. As such, before interviews were conducted, the aims, purposes as well as implications of the study were fully explained to all participants. Additionally, all participants were required to sign letters of informed consent before the interview dates.

1.11.3 Voluntary Participation

Voluntary participation prescribes that participants should not be compelled, coerced or required to participate in a study (McMillan & Schumacher, 2014:130). Participants in this study were provided with all the information regarding their participation in the study and were given time to decide whether they were willing to participate or not. Saunders *et al*. (2019:258) further stressed that when interviewing participants, informed consent should be evidenced and supported by a more detailed written

agreement, such as a consent form signed by both parties. Cohen et al (2018:125) further stressed the need for seeking permission to gain access to sites or individuals. As such, in addition to consent forms for all participants, principals of all the three schools in the study sample were approached to provide permission for interviews and observations to be conducted at their schools.

1.11.4 Confidentiality

Stake (2010:207) summarised confidentiality as the need for a researcher to avoid soliciting private information, that is not directly related to the study being pursued. The confidentiality requirement of ethical consideration prescribes that access to individual data and/or names of participants should be restricted only to the researcher and that all information is solely used for the purpose of that study. Confidentiality can be enhanced by ensuring that data and information cannot be linked to participants by name and also by ensuring that the materials like papers and electronic devices that contain the data and names are kept physically and electronically secure (Saunders et al., 2019:258). All the electronic devices that were used in this research, a laptop and smartphone, were and still are password protected and all physical papers were strictly kept in lockable drawers both at home and at the workplace.

1.11.5 Anonymity

McMillan and Schumacher (2014:134) explain anonymity to entail that participants cannot be identified from the data or information that had been gathered. In other words, the researcher or reader should not be able to identify who said or did what from the information gathered and recorded. Although anonymity is not easy to achieve in face-to-face interviews, in this research, this shortfall was mitigated by avoiding names or any information on interview notes, audio recordings and on verbatim transcriptions.

1.11.6 Harm or Risk to Participants

It is an ethical requirement that research should not expose participants to any form or risk of danger whether physical, mental or psychological. This danger encompasses risk of injury, harassment, punishment, negative impacts on school performance, societal standing, home life or friendships (McMillan & Schumacher, 2014:131). Saunders *et al*. (2019:185) further asserted that avoidance of harm or non-maleficence

is generally viewed as the cornerstone of the ethical issues that confront those who undertake research. This is so because the way the researcher obtains consent, preserves confidentiality, collects data from participants and the way in which data is used, analysed and reported, all have the potential to cause harm to participants. In order to minimise harm or risk to participants in this study, the researcher assessed the circumstances surrounding each individual participant and took all reasonable steps to avoid any kind of danger that could possibly befall any of the participants.

The UNISA Research Ethics Committee outlines the parameters under which student researchers conduct their studies. Among other requirements, there is need to keep confidentiality on all details of participants, the need to prevent loss of life of participants and also avoid undue stress and anxiety on the participants.

1.12 CHAPTER DIVISION

Chapter 1: Overview and the Background of the Study - This section provided the general overview of the topic of the research study and laid the foundation to and the background of the research.

Chapter 2: Literature Review - The literature review chapter analyses relates studies in the field of poor academic performance in South Africa in general and poor academic performance in township schools.

Chapter 3: Methodology and Research Design - This chapter explains the research paradigm, design, methods and approaches that were adopted for the study.

Chapter 4: Data Presentation, Findings and Interpretation - This chapter outlines the findings that emerged from data obtained using the data collection tools explained in the methodology chapter, with major themes being categorised, collated and interpreted.

Chapter 5: Conclusion, Implications and Recommendations - In this chapter, conclusions are drawn from the major findings and interpretations and recommendations for policy and practice offered.

1.13 SUMMARY

In this chapter the orientation of this study was laid down. An introduction was provided which outlined the broader societal aspirations of the South African government and the use of education as a transformational tool. The introduction also outlined the broad challenges faced by the South African education system and particularly challenges in schools in the previously disadvantaged communities. A brief literature review focusing on poor performance in mathematics was provided which established that factors that affect the collective management process of mathematics teaching and learning and hence contributing to poor academic performance in mathematics can generally be grouped into three broad categories which are family level factors, school level factors and system and policy level factors. This brief literature review provided the basis upon which the theoretical framework was established which led to the definition of terms. Following the background was the statement of the problem which was followed by research questions, aim and objectives. This study intended to establish factors that impact mathematics teaching and learning mainly focusing on factors contributing to poor learner performance in mathematics in secondary schools in the Highveld Ridge East Circuit in the Gert Sibande District of Mpumalanga, South Africa. This study following a qualitative research approach, was underpinned by a constructivist research paradigm and was guided by a multisite case study which involved three (3) secondary schools with data being collected via in-depth interviews, observations as well as document analysis. Finally, the layout and purpose of all the chapters in this study were described.

CHAPTER 2: LITERATURE STUDY AND THEORETICAL FRAMEWORK

2.1 INTRODUCTION

This chapter reviews current literature on factors influencing poor academic performance in the world in general and South Africa in particular, as well as presenting the contextual, conceptual and theoretical frameworks that guided the execution of this study. The major emphasis of the review is on factors influencing performance of learners in mathematics and other closely related subjects such as physical sciences. The factors influencing learner performance in general and learner performance in mathematics, have been the subject of various qualitative inquiries in South Africa and across the world at large. The broader consensus among scholars is that these factors emanate from the broader government policy and regulatory environment, school's environment, home and social environments of learners as well as other biological and psychological factors specific to individual learners. As such, these factors require close collective management processes between parents, learners, communities and school management teams. The subsection on the literature explores in detail the major findings in those studies. Finally, the chapter concludes with a summary of all subsections highlighted above.

In this section, a review of literature concerning poor academic performance of learners in South African schools in general, and poor academic performance in mathematics in particular, is conducted. In this review, some studies explore general poor performance in all South African schools but the main emphasis is on township schools. Particular interest of this study is to examine learner performance focusing on factors influencing such academic performance in mathematics. Generally, these factors can be grouped into parental and social level factors, school level factors and system and policy level factors. Studies in academic performance of learners in secondary schools in South Africa have taken various foci and designs. One strand of studies focuses on general academic performance for schools for all subjects (Masitsa, 2004; Louw *et al.,* 2011; Van der Berg *et al*., 2011; Udida, Ukwayi & Ogodo, 2012; Bayat *et al.,* 2014; Maddock & Maroun, 2018; Roodt, 2018; Mlachila & Moeletsi, 2019). Another strand of studies focuses on mathematics and science subjects (Mji &

Makgato, 2006; Makgato, 2007; Alt, Arizmendi & Beal, 2014; Sinyosi, 2015; Heeralal & Dhurumraj, 2016; Gniewosz & Watt, 2017; George & Adu, 2018; Rankhumise, 2018; Makofane & Maile, 2019; Naidoo & Kapofu, 2020; Ajimudin, 2021; Mabena et al., 2021; Moleko, 2021; Graham, Mokgwathi & De Villiers, 2021; Wawan & Retnawati, 2022; Gabina *et al.,* 2022; Wardat *et al.,* 2022). Designs of these studies differed slightly on the measure of academic performance with some studies using final matric pass rates while other studies used dropout rates, completion rates, grade promotion and grade repetition.

Various factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of learners in South African secondary schools and such factors can be broadly classified into three broad categories which are parental and social level factors, school level factors and system and policy level factors. Different studies have identified varying factors depending on the place where the studies were conducted and also on the aims and objectives of the studies.

2.2 PARENTAL AND SOCIAL LEVEL FACTORS

Parental and social level factors can be defined as those factors that emanate from families and societies from which the learners come and include amongst others, income levels, nature of caregivers, guardians and parents, family size and neighbourhood (Heeralal & Dhurumraj, 2016:309) as well as educational attainment and social status of caregivers (Sinyosi, 2015:27). Various studies have found that the performance of learners at schools largely depends of the learners' family characteristics. These findings are supported by the Bronfenbrenner's bioecological model of human development which specifies that the development of a human being partly depends on the microsystem where the developing person is exposed a fairly regular basis over extended periods of time (Bronfenbrenner & Morris, 2006:796). The findings are substantiated by Taylor and Baker's (2006:385) theory of learning performance which stipulates that the performance of learners is heavily impacted by the environmental issues surrounding the learner both at school and at home and the immediate community at home.

2.2.1 Parental Involvement in the Education of their Children

Studies found that performance of learners partially depends on the level of support and help they get at home with their homework and school work in general. Learners who come from families with educated caregivers, who help them with their homework and ensure that their school work is done properly, tend to perform better than children who come from families where they do not receive help. In a study carried out a study in District 3, Tshwane North, Mji and Makgato (2006,253:261) conducted group interviews with ten Grade 11 learners from each of the seven sampled schools with poor mathematics pass rates as well as one-on-one semi-structured interviews with ten educators from the participating schools. The study revealed that lack of parental involvement in their children's mathematics education contributes greatly to poor performance in that subject. They went further to explain that parental involvement in the education of their children is very important. Parental involvement includes checking that their children are doing their homework, that their children are attending classes, that they allow their children sufficient time to do their homework amongst other home chores and finally, parents should also encourage their children to do subjects in which they have some understanding themselves or other immediate family members or friends.

Other studies which explored poor learner performance in mathematics have also reached similar findings. Makgato (2007:89-98) studied factors contributing to poor academic performance of learners in mathematics and physical science by conducting focus group interviews of five to six learners from each of the seven sampled schools as well as one teacher from each of the seven participating schools. Aligning with Mji and Makgato (2006:261), Makgato (2007:98) found that inadequate parent involvement in their children's school matters, which includes attending parent school meetings and parent-teacher-learner consultative meetings, had a major impact on learner performance.

In a study to establish factors causing poor learner performance in mathematics in secondary schools in the Nzhelele East Circuit of Limpopo, Sinyosi (2015:51-52) identified that many parents do not have matric qualifications and as such, are semi-illiterate and/or total illiterate in mathematics. As result, most learners lack parental support in mathematics at home and in some cases, learners lived alone without

parents to support them. Heeralal and Dhurumraj (2016:314) further discovered that most parents are working and do not have time to assist their children with school work, hence they perform poorly in physical sciences. Gniewosz and Watt (2017:1380) went even further to identify that it is not only the assistance that parents give to their children in mathematics at home but more importantly, the beliefs and views of parents and teachers in learners' mathematical abilities which play a major role in stimulating interest and enhancing the development of intrinsic mathematical skills. Mabena *et al.* (2021:462) not only identified lack of parental involvement in the education of their children but also the behaviour of parents as well as the perceptions of teachers towards their learners' mathematical abilities.

2.2.2 Income Levels and Social Statuses of Parents and Caregivers

Income levels and family size were also found to have a significant impact on learner performance. Mlachila and Moeletsi (2019:34) discovered that leaners from poor families generally perform poorly compared to leaners from high-income families. This can be explained by resource availability. Leaners from high-income families can afford extra tuition in the form of extra classes and in some cases, can afford private tutors to assist in mastering content (Sinyosi, 2015:54). Udida *et al*. (2012:135) also found that learners with parents who have better jobs and are better educated, are exposed to more educational and cultural resources at home and as a result, these learners tend to perform better than their counterparts at school.

2.2.3 Household Status and Family Characteristics

Heeralal and Dhurumraj (2016:310) found that at schools in KwaZulu Natal, leaners' family background affected their academic performance and learning processes in physical sciences. Such factors include socio-economic status, two-parent versus single parent households, divorce, family size and neighbourhoods. This aspect of the socio-economic status of learners' families was also highlighted by Rankhumise (2018:99) as a factor affecting learner performance. Bayat *et al*. (2014:51) went further to argue that most learners at underperforming schools come from families where both the nuclear and extended family units have disintegrated and, in most cases, learners do not live with their biological parents. As such, these household and family structures affect the learners' system of beliefs, norms, values and knowledge and hence their performance at school in general and mathematics in particular.

2.2.4 Learner Characteristics, Motivation and Attitudes towards the Subject of Mathematics

Sinyosi (2015:54) discovered that most learners have a negative attitude towards mathematics and therefore are not keen in studying the subject. This finding was also revealed by studies conducted by Heeralal and Dhurumraj (2016:312) as well as Rankhumise (2018:99). In a study to investigate female learners' perceptions in learning geometry in mathematics, Naidoo and Kapofu (2020:1) discovered that female learners have negative attitudes towards the mathematics topic of geometry, in particular as a topic and mathematics in general as a subject. The major perceptions that were identified include the perceptions that mathematics is not an easy subject, it is confusing and stressful and that mathematics is time-consuming. This is also coupled by indiscipline of the learners (Mabena *et al.,* 2021:459). In addition, Wawan and Retnawati (2022:417) highlighted that learners' motivation as well as their perceptions of learners towards teachers' competency also influences their performance in mathematics. These perceptions resulted in negativity and therefore poor learner performance in mathematics as a whole.

2.3 SCHOOL LEVEL FACTORS

School level factors relate to conditions that are specific at individual schools. These factors include leadership, management and organisational systems; absenteeism, truancy, late coming and early departure from school by teachers and learners before the official time; class sizes, overcrowding and teacher to learner ratios; school buildings, facilities and amenities; safety and security of the school ecology; discipline, teachers and learners' accountability at schools; contact time in classrooms and non-completion of the curriculum. The findings on school level factors are consistent with the components of the learning environment and the presentation of learning material, as outlined by the Taylor and Baker's (2006:385-386) theory of learning performance. Additionally, according to Bronfenbrenner's bioecological model of human development, school level factors can be situated in the microsystem as well as the mesosystem (Bronfenbrenner, 1979:209; Bronfenbrenner & Morris, 2006:796).

2.3.1 School Leadership, Management and Organisational Systems

School leadership, management and organisational systems have been identified by several scholars as the most significant school level factor that affects learner

performance (Bayat *et al.,* 2014:47). This factor involves school principals, the school management team (SMTs) and the school governing bodies (SGBs) (Louw *et al.,* 2011:47). Low performance in schools has been found to be associated with weak and incompetent principals who have little or no management qualifications and skills, which is compounded by the fact that administrative duties assigned to principals often distract them from their central task of leading the teaching and learning process (Mlachila & Moeletsi, 2019:34, Wardat *et al.,* 2022:20). Furthermore, most principals themselves do not feel that instructional leadership, which includes leadership in teaching and curriculum implementation, is part of their role (Van der Berg *et al.,* 2011:8).

On the other hand, Bayat *et al.* (2014:47) attributed poor academic performance of learners to the unhealthy relationship between the school management teams (SMTs) and principals. In some cases, the relationships are tense and in extreme cases, these relationships are dysfunctional or non-existent. Issues affecting such relationships are the quality of leadership and communication skills of principals, failure by the principals to take action against undisciplined teachers and learners and failure by the principal to protect teachers against abusive parents. All these issues negatively affect the quality of teaching and learning at schools, causing poor performance of learners.

2.3.2 Truancy, Late-Coming and Absenteeism

The South African Schools Act stipulates compulsory attendance for learners from Grades R – 9. However, several studies have widely cited truancy, absenteeism, late coming and early departure by both learners and teachers as still prevalent and as a one of the causes of poor learner performance in South African schools. Poor performance in most schools was found to be associated with high levels of teacher and learner absenteeism (Bayat *et al.,* 2014:49). According to Mlachila and Moeletsi (2019:32) in South African schools on average, teachers miss eleven percent (11%) of teaching time due to absenteeism, twenty percent (20%) of teachers are absent on Mondays and Fridays while 33% are absent during month ends. Masitsa (2004:229) reinforced the issue of absenteeism of teachers:

> *"absenteeism or truancy, which is the legacy of the period of the "struggle against apartheid" is rife in township schools. Secondary school learners, in particular, became insubordinate and disobedient to school authority.*

They would arrive late at school and leave before the end of the school day or simply stay away from school for a couple of days or weeks… (The) wholesale neglect of school work, high-rate absenteeism or truancy, a negative attitude to school work, lack of self-motivation and low morale — all ultimately lead to poor matric results".

2.3.3 Teachers' Workloads, Syllabus Length and Completion

Another aspect that is closely related to truancy and absenteeism is non-completion of the curriculum prior to learners writing their final year-end examinations. Masitsa (2004:229) has attributed non-completion of the curriculum to truancy and absenteeism; however, with regard to poor performance in mathematics, Mji and Makgato (2006:261) observed that there is a disagreement between learners and teachers on the causes of non-completion of mathematics and physical science curricula with learners blaming teachers for spending most of the time on topics in which they are knowledgeable and less time on challenging topics. On the other hand, teachers blame breaks, holidays, sports and other events for consuming much of the time that should be used for teaching and learning. Ultimately, both learners and teachers agreed that allocated time is insufficient to complete the curricula of both mathematics and physical sciences. Rankhumise (2018:99) also discovered that failure to complete the curriculum by teachers and learners also contributes largely to poor performance of learners in physical sciences, which might also be true for mathematics.

2.3.4 Teachers' Quality, Content Knowledge and Experience

In a study to establish factors influencing poor performance in mathematics in the Bohlabela Cluster of Limpopo, Makofane and Maile (2019:43-45) conducted face-to-face interviews with four teachers, two learners, and two mathematics heads of department, two principals and one mathematics curriculum advisor in the cluster. The school level factors that affect the collective management process of mathematics teaching and learning and hence caused poor performance of learners in mathematics were identified as poor subject content knowledge and delivery by mathematics teachers as well as limited contact time for mathematics teaching and learning. In addition to the above, George and Adu (2018:135;145) carried out a study to

investigate motivation and attitude of Grade 9 learners in mathematics in the King Williams Town Education District of the Eastern Cape. Their study revealed that the way and manner in which mathematics teachers present the subject to learners leads to lack of motivation and interest by learners in mathematics, which negatively impacts on learner performance in that subject. Sinyosi (2015:67) went further to argue that school management teams (SMTs) themselves are not providing sufficient instructional leadership to mathematics teachers. This is manifested as failure by the SMTs to monitor the performance of mathematics teachers, to check whether the curriculum is implemented properly and to ensure that teachers are provided with the necessary resources and moral, emotional and psychological support so as to motivate the teachers who interact more with the learners.

The issue of quality of teachers in terms of their qualifications, experience and subject content knowledge has also been cited by many scholars as a factor contributing to poor performance of learners at secondary schools in South Africa. The national policy regarding teacher training and development in South Africa stipulates that the standard teaching qualification in any learning area, subject or phase should be a four-year Bachelor of Education (BEd) degree or an Advanced Diploma in Education for those with relevant non-teaching degrees (DoE, 2006:14). Additionally, the Employment of Educators Act (Act No. 76 of 1998) stipulates that educators should be employed on their ability to teach the subject(s) for which they are hired to teach (Government of South Africa, 1998:6). In a study of factors contributing to poor learner performance in mathematics in the Nzhelele East Circuit in the Vhembe District of Limpopo, Sinyosi (2015:68) established that most mathematics teachers do not have sufficient content knowledge for the subjects they teach and additionally, they do not attend enough workshops aimed at continuous professional development to improve their knowledge and pedagogy.

As a result of lack of sufficient subject content knowledge, performance of learners in schools is seriously affected. Makofane and Maile (2019:44) further highlighted that, after many years in teaching, teachers will still rely on the content knowledge they had gained in their pre-service training at college and universities, and therefore they encounter challenges in teaching newly introduced topics in the curriculum. Rankhumise (2018:99) went further to identify that lack of professional development for mathematics teachers compounds the aspect of poor content knowledge and

delivery methods. Regarding the impact of teaching experience, Bayat *et al.* (2014:50) found that good learner performance is associated with teaching experience, as measured by the number of years of teaching, and highest qualifications of the teachers. They further established that alignment of subject training and actual subject taught improves learner performance. Subject misalignment whereby teachers are teaching subjects for which they are not directly trained, mainly in content subjects such as mathematics, physical sciences and accounting, have been found to contribute to poor learner performance. Mji and Makgato (2006:260) further pointed out that poor teaching methods and strategies also contribute to poor learner performance, which is compounded by teachers' lack of adequate knowledge in some sections of the content of the curriculum.

South African teachers generally have lower subject content knowledge than their peers in Sub-Saharan African countries and it is argued that in some instances, teachers are outperformed by the learners they teach (Mlachila & Moeletsi, 2019:31). The relatively weak content knowledge of South African teachers therefore limits their ability to correctly assess their learners' performance and also their ability since they cannot impart the knowledge that they themselves do not possess. Another aspect that was found to impact negatively on learner performance was teacher preparation for classes. Studies revealed that teachers go to classes unprepared and use the lesson times to prepare and in the process, valuable time that should be used for teaching and learning is unnecessarily lost (Louw *et al.,* 2011:89; Bayat *et al.,* 2014:51). Another aspect that is closely related to teacher quality, qualifications and subject content knowledge is actual shortage of teachers with the qualities of qualifications and experience, especially for core subjects such as science, technology, engineering and mathematics (STEM subjects) (Makofane & Maile, 2019:44). Closely related to teacher quality is the level and manner in which teachers interact with their learners. Ajimudin (2021:135) found that negative teacher-learner relationships negatively affect performance of learners in mathematics.

Mabena *et al.* (2021:457) conducted a study to establish factors contributing to poor learner performance in selected schools in Mpumalanga, which is the province of focus for this study. The study established that lack of pedagogical content knowledge is one of the challenges in mathematics teaching and learning and therefore, a cause for poor performance of learners in mathematics in the province. The study also found

that it is not only content knowledge but also lack of professional development and training for teachers (Mabena *et al.,* 2021:458).

2.3.5 Large Classes and High Teacher-To-Learner Ratios

The issue of large classes, the high teacher-to-learner ratio as well as overcrowding were also cited as critical factors that affect the collective management process of mathematics teaching and learning and hence influence academic performance of learners in South African secondary schools. According to Masitsa (2004:223), a normal classroom is supposed to have 35 learners and any classroom with 40 or more leaners is classified as overcrowded or large. According to the Department of Education (DoE, 2009:66) since 1995, the agreed norm on learner to teacher ratio was 40:1 for primary schools and 35:1 for secondary schools; however, Bayat *et al.* (2014:49) found that most poor performing schools have overcrowded classrooms with a teacher to learner ratio of 40 and above. Overcrowded classrooms make it difficult for teachers to move freely between desks and even between the front row and the chalkboard. This overcrowding of the classroom, together with high learner-to-teacher ratios, makes individual learner assistance during classes practically impossible. Additionally, overcrowded class sizes are difficult to control, enforce discipline and monitor daily progress (Louw *et al.,* 2011:67).

Heeralal and Dhurumraj (2016:304;315), in a study to examine factors that contribute to poor learner performance in physical sciences in the Pinetown District of KwaZulu-Natal, discovered that large classes and overcrowding of learners lead to poor learner performance. In a similar study to establish causes of poor performance in physical sciences in the Botheo District, Free State, Rankhumise (2018:99) also found out that the large teacher to learner ratio is a major contributor to poor performance, a finding that may also hold true for poor performance in mathematics.

2.3.6 Safety and Security in the School Environment

Another school level factor that affects the collective management process of mathematics teaching and learning and hence influences learner performance in mathematics, is the safety and security within and around school premises. Graham *et al.* (2021:1) studied safety factors that are associated with mathematics achievement in South Africa using a combination of qualitative and quantitative methods. The study established that safety and security factors that impact on learner

achievement in mathematics do not only emanate from the school environment but also from the home environment. The specific findings on safety issues at home were that learners insulted by family members or who experience insults among family members, tend to perform poorly in mathematics and learners who have experienced theft and/or are forced to do things they do not like, also perform badly in mathematics. At school, safety and security issues that impact on the collective management process of mathematics teaching and learning, revolve around the feeling of safety within the school environment with regard to physical security measures such as security fences and security guards (Wardat *et al.,* 2022:20). Secondly, the issue of theft and vandalism especially during school holidays, was also found to have a negative impact on learner performance in mathematics (Graham *et al.,* 2021:8).

Louw *et al.* (2011:70) identified that poor academic performance of learners can be partly caused by low security and safety for both leaners and teachers and thus schools located in crime, drug and gang-infested areas are more prone to underperformance than schools in quiet and crime-free areas. Violence and social disorders in communities often have spill-over effects in schools, thus negatively affecting teaching and learning in surrounding schools since teachers and learners do not feel safe and cannot fully concentrate. Underperformance in schools has also been associated with intimidation of teachers and learners, and violent and aggressive behaviour in classrooms, which makes teaching and learning difficult (Bayat *et al.,* 2014:50).

2.3.7 State of Classroom Infrastructure and Amenities

In addition to safety and security, the state of school buildings, facilities and amenities has also been found to influence learner performance in South African schools. Louw *et al.* (2011:68) found that lack of adequate ventilation of classrooms, insufficient desks and chairs and the poor quality of most basic equipment, poor lighting and small classroom spaces coupled with overcrowding, all contribute to poor performance predominantly in rural and township schools. Poor performance of learners is mainly attributed to lack of concentration of learners in poor physical conditions, ultimately leading to negative perceptions and demoralisation.

2.3.8 Availability of Teaching and Learning Materials

Another school level factor that negatively affects academic performance of learners at secondary schools is lack of adequate resources such as textbooks, libraries and laboratories. The distribution of resources among schools is uneven, with some schools being adequately resourced and other schools, mainly located in rural and township areas, being poorly and inadequately resourced (Mlachila & Moeletsi, 2019:34). According to Heeralal and Dhurumraj (2016:312), shortage of textbooks results in poor academic performance by learners in schools and this is further compounded by the fact that learners or their parents and guardians cannot afford to purchase textbooks to make up the deficit. Rankhumise (2018:99) similarly found that textbook shortages and poor textbook quality impact negatively on learner performance in physical sciences in the Botheo District, Free State. This is corroborated by Ajimudin (2021:136) who discovered that although teachers might have copies of textbooks, learners find it difficult to access those textbooks which might necessitate the use of photocopies to ensure access by all learners.

Similar to the studies above, Mlachila and Moeletsi (2019:37) found that schools with textbook shortages and no library facilities tend to perform poorly compared to schools where there are sufficient textbooks and large library facilities. For technical and practical subjects such as physical sciences, life sciences and others, lack of laboratories and equipment also causes poor performance in those subjects, since learners will understand better with educators demonstrating or conducting experiments, supplement what is in textbooks and as a result, learning is enhanced. An advantage of applying theory to practice as in a laboratory, helps improve learners' higher order learning skills such as analysis, problem solving and evaluating (Mji & Makgato, 2006:260). In a more recent study conducted in Abu Dhabi in the United Arab Emirates (UAE), Wardat *et al.* (2022:20) established that generally principals are of the view that schools lack resources in general and in particular, library and instructional (teaching and learning) resources.

2.4 SYSTEM AND POLICY LEVEL FACTORS

System and policy level factors are those factors caused by macro level factors such as government laws, policies and preferences; environmental, cultural and social dynamics; religious and political dynamics as well as the general state of the macro

economy. These factors are pervasive among all schools in a region, province or the whole country. Major factors that were identified in this category include language of learning and teaching (LoLT); lack of proper foundation at primary school level; inappropriate grade promotion policy; and militancy and influence of trade unions (Masitsa, 2004; Mji & Makgato, 2006; Louw *et al.,* 2011; Bayat *et al.,* 2014; Heeralal & Dhurumraj, 2016; Roodt, 2018; Makofane & Maile, 2019; Mlachila & Moeletsi, 2019). System and policy level factors are conceptualised by Bronfenbrenner's bioecological model of human development under the exosystem and the macrosystem (Bronfenbrenner, 1979:237;258).

2.4.1 Language of Learning and Teaching

The most significant macro level factor revealed by the majority of scholars was the language of teaching and learning (LoLT) which can also be referred to as language of instruction. Although the language-in-education policy stipulates that the school governing bodies should choose a language of learning and teaching which is an official language in South Africa, the National Department of Basic Education's formal language policy regulation prefers English and Afrikaans as the medium of teaching and instruction at secondary schools (Louw *et al.,* 2011:58). The use of English, as the preferred medium of instruction in township schools, stems from the recognition that South Africa is multilingual and English is the language of learning in most countries of the world as well as a major language of commerce. Another reason is that indigenous languages do not have the linguistic complexity to enable them to be used in technical and scientific contexts (Masitsa, 2004:220), hence the move to English or Afrikaans as the language of learning and teaching at Grade 4 level.

According to Mlachila and Moeletsi (2019:36), the majority of South African learners, predominantly African with their own home language, do not have a good command of the languages of English or Afrikaans, even though these two languages are officially used as media of instruction in schools. This finding concurred with Mabena et al (2021:462) who also discovered that language has a huge impact on the performance of learners in mathematics, exacerbated by the fact that learners and teachers use their home language in the teaching and learning of mathematics.

During the apartheid era, the language of instruction, mainly Afrikaans, was used as a tool for racial or class discrimination, (Roodt, 2018:9). Bayat *et al.* (2014:49) further

observed that English, as the medium of instruction and learning, is the biggest and serious constraint on effective learning and instruction. Additionally, although English is the official language of teaching and learning, teachers predominantly in black schools, use their mother tongue language to teach and instruct learners. This then creates challenges in assessment and examinations as the learners are required to write and answer in English or Afrikaans. When learners have to use a language in which they are not proficient, mastering content (both practical and theoretical) of a subject becomes difficult and this in turn, affects the learners' performance mainly in technical subjects because language plays an important role in the understanding of the subject's technical terms (Haaralal & Dhurumraj, 2016:310).

Studies to explore causes of poor performance, specifically in mathematics and physical sciences, also identified the use of English as the language of learning and teaching as one of the main causes of poor performance in mathematics. Mji and Makgato, (2006:263) as well as Makgato (2007:99-100), found that performance of learners in mathematics and physical sciences is wholly dependent on the ability of the learners to master the English or Afrikaans language. Inadequate development of communicative academic language proficiency (CALP) (*cf.* Cummins, 1979) directly results in learners failing to understand the abstract and content aspects of mathematics and physical sciences in which English is used as the medium of instruction (Makofane & Maile, 2019:44). This is further corroborated by findings by Heeralal and Dhurumraj (2016:310) who revealed that the language of teaching and learning plays a major role in the performance of learners in subjects which require proficiency in language, which relates to Cummins' notion of CALP.

A more recent study by Moleko (2021:1) looked at the influence of language proficiency such as reading skills, understanding mathematics language and structure, and ambiguities on visualisation of mathematics word problems. The study concluded that one of the causes of factors influencing effective mathematics teaching and learning and therefore learner performance in mathematics, was lack of visualisation of mathematics word problems, which is in turn caused by lack of reading skills and lack of understanding of mathematics language, structure and ambiguities (Moleko, 2021:14).

2.4.2 Lack of Proper Foundational Knowledge from Lower Grades and Phases

Poor quality of education at primary school levels and therefore lack of foundational knowledge for learners who enter secondary schools, is also as a major factor identified by many scholars. The poor quality of education at primary school level is perceived as one of the main causes of poor performance in secondary schools by educators, principals, SMTs and SGB members (Bayat *et al.,* 2014:47). Sinyosi (2015:49) further posited that learners enter secondary school level with a poor foundation of the basics of the subjects, mainly in mathematics. Maddock and Maroun (2018:200) blamed high failure rates in secondary schools on outcomes-based education (OBE) and pointed out that learners lack a strong foundation in primary schools, hence will struggle to learn, understand and adjust to the rigorous curriculum demands of secondary schooling. As regards to poor performance of learners in mathematics, Rankhumise (2018:99) discovered that learners generally lack good mathematical background and foundation, which should be laid during lower and intermediate grades. This poor mathematical background eventually inhibits the ability of learners to master mathematical concepts at higher grades of learning, thus leading to poor performance at senior phase level.

2.4.3 Weak Grade Promotion Policy for Lower Phases and Grades

Closely related to lack of foundation in primary schools, is the policy of grade promotion. The policy on grade promotion for the foundation, intermediate and senior phases of the General Education and Training (GET) band was outlined in this study under the policy framework under contextual framework. Basically, the National Policy pertaining to the Programme and Promotion Requirements of the National Curriculum Statement (NPPPR) Grades R – 12 stipulates that a learner cannot be retained for more than one year in each of the foundation, intermediate and senior phases (DBE, 2015:9;16;25). This therefore implies that it may be possible for many learners to be promoted to higher grades and phases before they have properly mastered the requisite knowledge and competence required to cope in the higher grades and phases to which they are promoted.

Louw *et al.* (2011:87) argued that the present promotion policy, whereby learners were allowed to advance to the next grade without having acquired the requisite intellectual development, has had a profound impact on the quality of learners entering secondary

school. The policy, as mentioned above, currently states that a learner may only repeat once per educational phase and as a result, this forces schools to promote learners to the next grade who have not understood the necessary subject content and competencies, as required by the curriculum (Bayat *et al.,* 2014:53).

2.4.4 Influence of Trade Unions on Learning and Teaching

Roodt (2018:7) highlighted the influence of teachers' labour unions on the quality of teaching and learning. Specifically, the militancy of the dominant union, the South African Democratic Teachers' Union (SADTU), was mentioned as one of the factors that impact negatively on learners' performance since instead of protecting the rights of teachers, SADTU is now actually infringing the rights of learners in the country. Several malpractices of SADTU were pointed out but the most worrying being the accusation that the union is opposing measures to improve education, its antagonistic approach, illegal strikes, and its use of policy matters as 'bargaining chips' to get its way.

2.5 THEORETICAL FRAMEWORK

A theoretical framework provides a general or broader set of ideas under which a study belongs and is based on existing theory or theories in the literature which has been tested and validated by other previous scholars. In this study, a theoretical framework was adopted with two theories guiding this study.

Two theories that guided this study were the Revised Bronfenbrenner's bioecological model of human development and Taylor and Baker's (2006) theory of learning performance. The Bronfenbrenner (1979, 2006) bioecological model of human development was chosen because it contains elements that were considered to cover parental and family level factors under the proximal processes and the developing person as well as system and policy level factors under the contexts mainly the exosystem. However, there is a weakness in articulating school level factors and hence a second theory was considered which is the Taylor and Baker's (2006) theory of learning performance which details factors that interplay in the academic environment.

2.5.1 The Revised Bronfenbrenner's Bioecological Model of Human Development

The revised Bronfenbrenner's bioecological model of human development is a product of years of evolution and modifications of various theories of human development from early 1970s (Ross & Tudge, 2013:243) and continues evolving. This study adopted the revised model as per Bronfenbrenner and Morris (2006), which was defined by Bronfenbrenner and Morris (2006:793) as an evolving theoretical system that can be used for the scientific study of human development over time. In basic form, the theory stipulates that an individual's development takes place under environmental conditions and the time for which the developing person was exposed to the environment. These combined with personal characteristics of the developing person will influence the outcomes of human development. Three of these elements proximal processes, context and time closely articulate parental and social level factors as well as the system and policy level factors.

The bioecological model of human development is multidisciplinary and interactive, focusing on age periods from childhood through adolescence and is applied in formulating policies and programmes pertinent to youth and family development. As a result, this makes it more suitable for modelling family and social level factors as well as system and policy level factors and their impact on performance of Grade 12 learners in mathematics since Grade 12 learners fall mainly in the adolescent stage of life.

The bioecological model of human development primarily comprises four principal components that are dynamic and interactive with one another. These components, explained in detail in the following subsections, are proximal processes, the person, the contexts and time (Bronfenbrenner & Morris, 2006:795).

2.5.1.1 Proximal processes

Rosa and Tudge (2013:252) summarised the definition of proximal processes from earlier work by Bronfenbrenner (1979) and Bronfenbrenner and Morris (2006). Generally, proximal processes can be defined as processes of progressive and complex reciprocal interaction between an active evolving biopsychological human organism and objects, persons and symbols in the immediate environment in which the human organism exists and such interaction has to occur on a fairly regular basis over

extended periods of time. In simpler terms, proximal processes represent regular interactions between a human organism and the environment over extended periods of time and such interactions are posited as the principal mechanisms through which human development takes place (Bronfenbrenner & Morris, 2006:795). Learners interact regularly with their home and societal environments as well as the school environments. At home, learners interact with parents, siblings, relatives, physical objects at home, neighbours, friends and everything that happens in their communities. All these interactions impact on the learners' behaviour, attitudes, motivations, beliefs and orientation in life. It can therefore be believed that a home and societal environment conducive for learning of mathematics can influence the learner's attitude and motivation towards mathematics. A negative environment, on the other hand, can negatively influence the attitude and motivation of the leaner towards the subject. In this study, this element provides a lens for exploring parental and social level factors.

2.5.1.2 Person

The biopsychological characteristics of the developing person also play a critical role in the development process of human beings, especially the adolescent. Three main characteristics of the developing person were identified by Bronfenbrenner and Morris (2006:795) as the most critical in shaping the direction and power of proximal processes. The first characteristic is dispositions which might be generative and constructive such as curiosity, tendency to initiate and engage in activity alone or with others, responsiveness to initiatives by others, readiness to defer immediate gratification to pursue long-term goals. Other characteristics of disposition can be disruptive and these include impulsiveness, explosiveness, distractibility, aggression, violence as well as the inability to defer gratification (Rosa & Tudge, 2013:253). These disposition characteristics shape the developmental domain and sustain them in a certain direction.

The second characteristic of the developing person are the bioecological resources of ability, experience, knowledge and skills which are required for effective functioning of the proximal processes at any developmental stage of a human being (Bronfenbrenner & Morris, 2006:796). Resource characteristics greatly influence the ability of the developing person to engage effectively in the proximal processes with some characteristics activating while others limiting, the development of the person.

Characteristics that activate development include ability, knowledge, skill and experience whereas those limiting development include genetic defects, low birth weight, physical handicaps, severe and persistent illness or damage to brain function (Rosa & Tudge, 2013:253).

The third characteristic of the developing person are demand characteristics that can promote or discourage reactions from the social environment in which reactions can either foster or disrupt the proximal processes. This characteristic is easily noted by the social environment and therefore greatly influences the reactions from the social environment (Bronfenbrenner & Morris, 2006:796). According to Rosa and Tudge (2013:253), demand characteristics of the developing person include agitated or calm temperament, attractiveness versus unattractive appearance, and hyperactivity and passivity as well as age, gender and skin colour.

In summary, the characteristics of the bioecological model encompasses three sets of characteristics of the developing person. These sets are disposition, bioecological resources as well as easily noticeable demand characteristics. Learners exude various types of personal characteristics which might positively and negatively affect the view of life, their beliefs and therefore their inclinations. However, these characteristics are shaped and sustained by home and societal conditions to which learners are continually exposed. These characteristics can influence the direction and pace of development of the learners which might affect performance in mathematics. This element of 'the person' provides guidance on analysing parental and social level factors.

2.5.1.3 The contexts

The contexts component of the bioecological model of human development focuses on the environments and systems within which a developing person is subjected. These systems include the microsystem, mesosystem, exosystem as well as the macrosystem (Rosa & Tudge, 2013:253). The major differences between these systems are on the intensity and duration that the developing person spends in the environments or systems.

In the microsystem, the members/persons or objects of the system or environment participate actively and intensely in the life of the developing person on a fairly regular

basis over extended periods of time. Members/persons included in the microsystem are, inter alia, parents, relatives, close friends, teachers, mentors, co-workers, spouses, or others who participate in the life of the developing person on a fairly regular basis over extended periods of time. The microsystem not only considers human beings that interact with the developing person but also objects in settings such as the family, child-care arrangements, schools, peer groups and neighbourhoods (Bronfenbrenner & Morris, 2006:796). In this study, the microsystem mimics the home and societal environment and the school environment. The microsystem, therefore, encompasses parental and social level factors.

The mesosystem has been defined by Bronfenbrenner (1979:209) as the set of interactions between two or more settings in which the developing person is an active participant; for example, the interconnections between home and school or between home and the televisions and other smart devices. The mesosystem occurs when the developing person engages in activities in more than one setting in that there is a transition from one setting to the other like a Grade 12 mathematics learner spending time at home as well as time at school. As a result of the transition in settings by the developing person, there exists intersetting communications whereby messages are communicated from one setting to the other with the express intention of providing information to persons in the other setting. The mesosystem entails transition of learners from homes and societies to schools and the reciprocal interactions between players in these environments. An example of such interactions maybe communication between mathematics teachers and parents of Grade 12 mathematics learners. Additionally, there is also intersetting knowledge which is the information or experience that exist in one setting about the other setting, such as parents knowing the details of mathematics teachers and teachers knowing the residential addresses and other home conditions of their learners. The mesosystem clarifies the need for collaboration between players in different settings, hence the justification for the collective management process of mathematics teaching and learning since the transition between these settings affects the way learners are managed and controlled collectively.

The third system or environment is the exosystem. Bronfenbrenner (1979:237) explained that an exosystem consists of “one or more settings that do not involve the developing person as an active participant but in which events occur that affect, or are

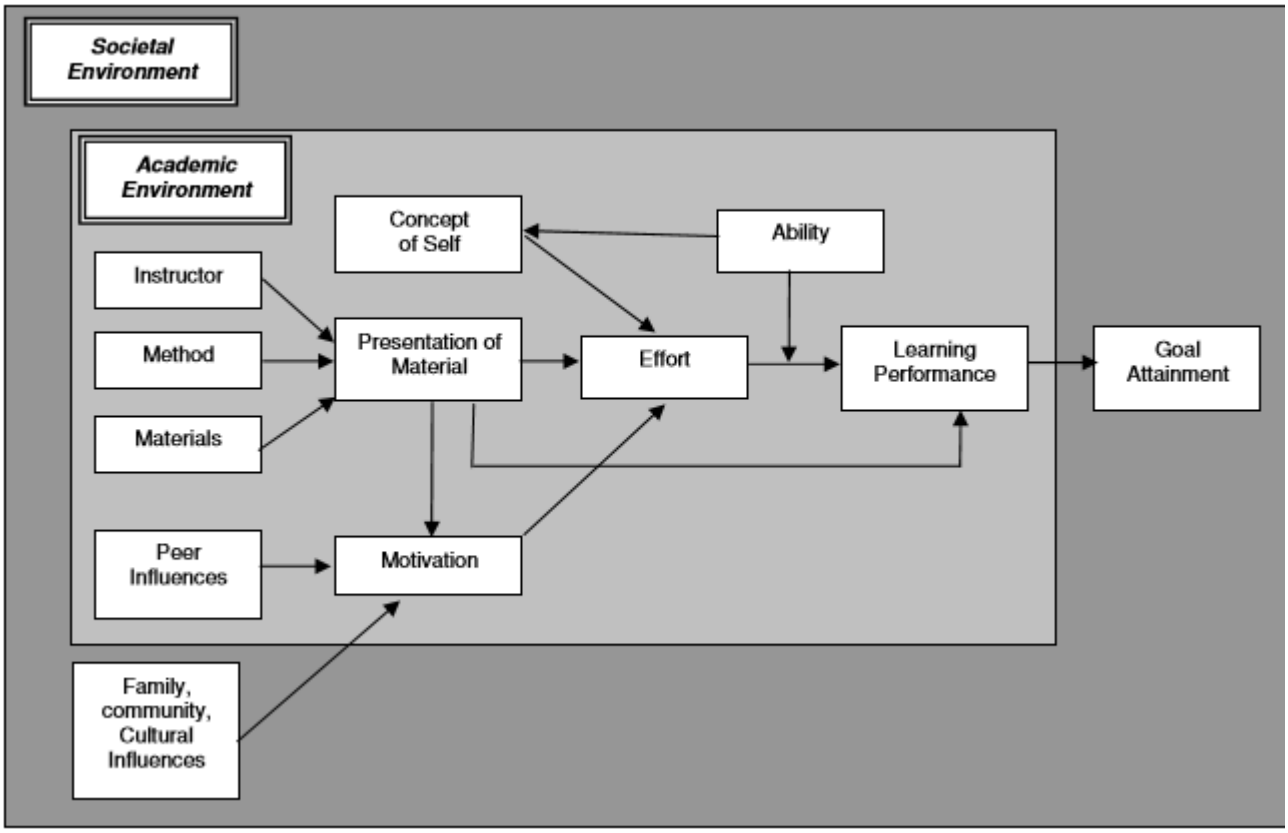
affected by, what happens in that setting". In the context of mathematics, the exosystem includes the interactions between the school management and district or provincial education officials where such interactions between the school management and district and provincial officials affect the way teaching and learning occurs at each individual school. In an exosystem there should be a causal link between the developing person and the setting where the developing person is not an active participant. In the example of the school management and the district and provincial officials, the principal or departmental heads are the causal links. This exosystem sphere encompasses the system and policy level factors that affect the collective management process of mathematics teaching and learning and hence influence learner performance in mathematics.

The macrosystem is identified by the consistency observed within the subculture or culture in the content and form as well as the belief systems and ideology underlying such consistency in individual systems in the micro, meso and exosystems (Bronfenbrenner, 1979:258). Although cultures and subcultures can be slightly different, they are relatively homogenous in the types of settings they contain, the types of settings that persons enter in certain developmental stages, the content and organisation of molar activities, roles and relations found within each type of setting, and the extent and nature of connections existing between settings entered into or affecting the life of the developing person. The macrosystem in the context of learner performance in mathematics is covered mainly in the parental and social level factors and to some extent, school level factors.

In summary, the microsystem denotes contexts in which learners spend most of their times and influences their behaviour strongly which mainly fall under parental and social level factors and school level factors. The mesosystem entails a transition of learners from one setting to the other, like from homes to schools and back and thus justifies the need for collective management of mathematics teaching and learning. Thirdly, the exosystem represents contexts in which learners are not direct or active participants but activities in those contexts directly affect the development of leaners. This clarifies system and policy level factors for this study.

2.2.5.2 Theory of Learning Performance

The theory of learning performance developed by Taylor and Baker (2006) is another theory which is relevant to this study of factors that affect the collective management process of mathematics teaching and learning and hence contributing to poor academic performance of Grade 12 learners in mathematics in secondary schools in the Highveld Ridge Circuit. According to Taylor and Baker (2006:384), the theory of learning performance was developed specifically for the academic environment at the high school, college or university level which makes it very suitable for students of Grade 12 learner performance in mathematics since such learners fall under the high/secondary school category. Although the theory is generic across all high school age subjects (Taylor & Baker, 2006:384), it can be applied to mathematics at Grade 12 level in this study. This theory has provided more clarity on the academic environment which covers what happens in the school settings including issues such as interactions among learners, interactions between learners and teachers, how mathematics is presented by teachers to learners and the availability of teaching and learning materials as well as the state of the school environment itself. The graphic representation of the theory of learner performance is represented in Figure 2.1 below.



(Source: Taylor & Baker, 2006:387)

Figure 2.1: Graphical representation theory of learning performance

In its basic form, the theory of learning performance is a goal attainment-oriented model (Taylor & Baker, 2006:384). In the case of this study, the goal attainment is academic performance of Grade 12 learners in mathematics. The theory of learner performance was built on Porter and Lawler's (1968) expectancy theory which outlines that the performance of individuals in any activity is determined by their perceived outcomes, the value they attach to such outcomes as well as the individuals' perceptions on their ability to achieve the desired outcomes. In summary, these concepts can be crystallised to reflect that an individual's motivation will be greatest when he/she believes that a certain behaviour or activity will lead to certain outcomes, he/she believes that the outcomes will bring positive value and he/she believes that he/she possesses the ability to achieve the desired level (Taylor & Baker, 2006:384).

The theory of learning performance was developed as an extension to this summary of concepts of Porter and Lawler's (1968) expectancy theory and has five broad components which are the major attributes and dispositions of the learner; the learning history and background of the learner; the environment within which the learning takes; the presentation of material by the instructor vis-à-vis the personality and attitudes of the learners and the role of the learner in relation to the instructor/learner relationship

In the theory of learning performance, there are three core attributes of the learner which influence the learner's performance. These attributes are the learner's motivation to learn, the learner's effort applied to learning as well as the learner's ability to learner. These three attributes combine to influence learning performance. The driving force in all these attributes and learning performance is the perceived value of the goal (which is the level of academic performance). However additionally the learning history and background of the learner plays a greater role in the current performance of the learner where a learner with a background of good performance is likely to perform better in his/her current studies (Taylor & Baker, 2006:384-385).

The environment under which the learner learns also plays a critical role in influencing learning performance of the learner. This environment encompasses the immediate academic environment which includes influences of peers and other school groups and the broader societal environment which includes community, cultural and family influences on the learner's attitudes and motivation towards school work and learning.

Another important dimension of learning performance is the presentation of learning material which is a combination of the attributes of the instructor, the methods used in presenting the material, and the subject matter itself. In other words, the qualities of the instructor and the teaching methods used to present the subject content vis-à-vis the subject matter itself (for example mathematics as a subject itself), greatly influence the effort and motivation of a learner. Not only that, but also the quality, personality and attitudes of the learners themselves affect the effectiveness of different teaching methods and presentation of material. As a result, there should be some conformity between instructor qualities, methods of teaching and the subject itself against the quality of the learners. This was termed as the 'fit' (Taylor & Baker, 2006:385-386).

The fifth component relates to the role of the learner in the teacher/learner relationship with a cordial relationship between the teacher and the learner likely to cause improved learning performance, whereas a strained relationship can cause poor performance. The status of such a relationship hinges on the learner accepting his/her role in the power imbalance of the teacher/learner relationship (Taylor & Baker, 2006:386). The Taylor and Baker (2006) theory of learning performance provides clarity on the factors that interplay in the school settings that include various interactions among learners and between learners and other stakeholders, such as teachers, and also the state of physical and material resources at the disposal of learners. All these interplays affect collective management of mathematics teaching and learning at school level.

2.6 SUMMARY

In summary, this chapter provided a detailed review of literature of studies that examined factors affecting the collective management process of mathematics teaching and learning. Generally, studies established that a number of factors that affect the collective management of mathematics teaching and learning, which can generally be grouped into three categories which are parental and social level factors, school level factors as well as system and policy level factors. Two theories were selected to guide this study and these are the Bronfenbrenner's (1979, 2006) bioecological model of human development as well as the Taylor and Baker (2006) theory of learning performance to complement each other so as to cover all the factors affecting collective management process identified in the literature review.

CHAPTER 3: RESEARCH DESIGN AND METHODS

3.1 INTRODUCTION

The research problem, aim, questions and objectives of this study were introduced in Chapter 1. In broad terms, the main aim of this study was to determine factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics in the Highveld Ridge East Circuit. In Chapter 2, the contextual, conceptual and theoretical frameworks that guided this study were discussed, together with a review of literature from previous related studies. Generally, the factors that influence learner performance in Mathematics, as well as other subjects, can be broadly classified into three categories which are parental and social factors, school-based factors as well as system and policy level factors. In this chapter, the research design and methods employed to achieve the aim and objectives of this study are outlined and discussed.

This chapter begins by outlining the research methodology which encompasses the research paradigm, research approach and the research type. The research methods are then be outlined which encompass study population, sampling techniques, data collection, data analysis, trustworthiness as well as ethical considerations. Finally, the summary gives a synopsis of the whole chapter.

3.2 RESEARCH METHODOLOGY

As indicated in Chapter 1, research methodology is defined as the way or process in which one collects and analyses data (McMillan & Schumacher, 2014:8). In other words, research methodology is considered the theory of undertaking research (Saunders *et al.,* 2019:4). The following subsections describe in detail the methodology steps adopted for this study.

3.2.1 Research Paradigm

A research paradigm can generally be defined as a knowledge claim, a philosophical assumption or a set of beliefs that shape the execution of a research (Mertens, 2015:55). Creswell and Creswell (2018:5) outlined that although the philosophical assumptions and worldviews can remain unspecified in a research study, it is advisable for individuals to specify them when preparing a research plan or proposal.

There are broadly four categories under which philosophical assumptions and worldviews fall which are positivism, constructivism, transformative and pragmatism (Creswell, 2014:4). The major differences between these research paradigms relate to different beliefs that the researcher hold on ontology, epistemology, axiology, methodology and rhetoric. Ontology refers to the nature or location of the truth or reality (Creswell & Clark, 2018:54).

Sekaran and Bougie (2016:28) added that every research is about establishing the truth or reality about a phenomenon, but they posed a question as to whether there is such thing as truth/reality or whether they only exist in the minds of people. Epistemology is the nature, origin, scope and justification of knowledge or simply how we know what we know (Creswell & Creswell, 2018:60). Methodology refers to the process that the research study follows in order to answer research questions (Creswell & Clark, 2018:21). Another element in shaping a philosophical worldview is axiology which deals with values that are embedded knowledge producing process. These values are determined by both purpose and perspective of the knowledge producing process and not all knowledge producing processes are equally suited for all research studies (Jason & Glenwick, 2016:14).

This study was premised under the interpretivist or constructivist research paradigm which maintains that in any scenario, there are multiple socially constructed realities (McMillan & Schumacher, 2014:4). With ontology, an interpretivist research paradigm holds that individuals seek understanding of the world they live in and they develop subjective meanings of their experiences where meanings are directed towards objects, things or other phenomena (Creswell & Creswell, 2018:46). With epistemology, this paradigm emphasises simplistic theories and concepts leading to gaining new understanding of things and possibly developing new theories. Values are to the research since the researcher is an active participant in what is being researched and the interpretation is subjective and therefore requires the researcher to be reflexive (Saunders *et al.,* 2019:145). The defining character of data collection is that open-ended questions are used so as to allow participants to express their views, feelings and opinions about the phenomenon under investigation (Creswell & Creswell, 2018:46).

This paradigm was considered best suited for this study because different participants have varying views and opinions on which factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of learners in mathematics and any other subject (ontology). Secondly, the researcher was active in the data collection stage through interactions with interviewees and observation participants and therefore had to maintain high moral and ethical standards (axiology). Thirdly, although a theoretical framework was designed, the progression of the study mainly data collection evolved as interviews and observations were conducted in the field (epistemology) and finally, data were mainly collected through open ended interview questions and observations in the natural classroom settings (methodology). Hence, it was believed that an interpretivist/constructivist research paradigm was the most appropriate for this research.

3.2.2 Research Approach

Creswell (2014:1) defined a research approach as a plan and the procedures for conducting a research inquiry spanning the steps covering broad assumptions to detailed methods of data collection, analysis and interpretation. The research approach chosen by the researcher is mainly influenced by the broad philosophical assumptions that the researcher brings to the study. There are three broad approaches to research which are qualitative, quantitative and mixed methods research (Creswell & Creswell, 2018:2).

Qualitative research approaches emphasise gathering and analysing data on naturally occurring phenomena and as such, data is mainly in the form of words, pictures, video clips and artefacts rather than numbers (McMillan & Schumacher, 2014:20; Saunders *et al*., 2019:179). According to Yin (2018:18), a qualitative research approach is also used to gain an understanding of underlying reasons, opinions and motivation and also to uncover trends in thought and opinions and dive deeper into the problem. Similarly, Mishra and Alok (2017:3) added that qualitative research involves looking in-depth into a qualitative phenomenon using non-numerical data. In qualitative research, data is mainly obtained through open-ended, in-depth interviews, observations and document analysis rather than closed-ended interview questions to establish deep understanding of a social phenomenon (Creswell & Creswell, 2018:41).

This study followed qualitative research approach since the main aim was to obtain an in-depth understanding of the factors underlying poor performance of Grade 12 mathematics learners and their impact on collective management process of mathematics teaching and learning. As such a qualitative research approach was believed to be ideal since it would enable the researcher to capture views of educators, parents and learners using interviews, observations and document analysis.

3.2.3 Research Design

McMillan and Schumacher (2014:28), broadly defined research design as the general plan of how the research is conducted including the description of subjects and the methods of data collection that are employed in a study. The purpose of a research design is to specify a plan for generating empirical evidence that can be used to address the research questions. Furthermore, a research design involves several decisions that the researcher has to make spanning the broad assumptions or worldviews applied to the specific methods that are used for data collection and analysis. The choice of a research design is influenced by the nature of the research problem that is being addressed, the researcher's individual experiences as well as the nature of the intended audiences of the study (Cohen et al., 2018:120). There are basically five types of research designs that fall under the qualitative approach and these are ethnography, phenomenological, case study, grounded theory and critical studies (McMillan & Schumacher, 2014:11).

An ethnographic research design is adopted when the purpose of the research is to gain an in-depth understanding of lived experiences, daily activities and interactions as well as the social context within which all those take place from the perspective of those being studied (Mertens, 2015:303). A phenomenological research design emphasises the view that an individual's understanding of the world is shaped by his/her immediate experience and the research has to understand, describe, explain and interpret such experiences. In other words, this type of study aims at describing, explaining and interpreting a phenomenon, experience or situation by understanding the meanings that the participants assign to them, either individually or as a group (Cohen *et al.,* 2018:300). Grounded theory research design on the hand is adopted to develop theoretical explanations behind social processes and interactions from the data gathered. Specifically, it is considered when the broad aim of the research is to

develop, discover or create theory (Saunders *et al.,* 2019:205). Critical studies derive from critical theory, feminist theory, race theory and they assume that knowledge is subjective. Researchers under this design view the society as structured by status and class, race, ethnicity, gender and sexual orientation (McMillan & Schumacher, 2014:32).

A case study is adopted when the purpose of a study is to provide an in-depth and extensive description of a certain social phenomenon (Yin, 2018:3). According to McMillan and Schumacher (2014:32), the focus of a case study may be on one entity (within-site study) or on multiple entities (multisite study) and various data collection methods are employed. There are several types of cases which include individuals, groups, activities, events or unique phenomena. Cases or instances can be selected based on a variety of characteristics or attributes possessed by the cases or instances (Cohen et al., 2018:179). In a multisite case study, various cases are combined into a single case and various sources of data and data collection methods are employed to examine the bounded system, or case(s), over time and in depth (2018:85).

This study adopted a multisite case study research design which incorporated three schools in the Highveld Ridge East Circuit as the multiple cases. The purpose of this study was to explore the views and meanings that parents, mathematics departmental heads as well as principals attached to factors affecting the collective management process of mathematics teaching and learning and leading to poor academic performance of Grade 12 learners in mathematics. Case study research was thus believed to be appropriate since it allowed the researcher to gain in-depth understanding of factors that affect the collective management process of mathematics teaching and learning and hence influencing learners' performance in mathematics in the Highveld Ridge East circuit. Different data collection methods were employed which included in-depth interviews, observations and document analysis

3.2.4 Research Methods

Saunders *et al*. (2019:502) posited that the use of different data collection methods within one study ensures that the data collected are cross validated with each other to enhance truthfulness. In this study, three in-depth interviews, one non-participant observation as well as document analysis were conducted at the premises of each of the three schools selected in the multisite case study. In total nine (9) in-depth

interviews, three (3) non-participant observations and policy document analysis were planned for this study. Creswell and Creswell (2018:18) explained that research methods outline forms of data collection, analysis and interpretation that a researcher employs in a research study. Since the study adopted a qualitative research approach and a multisite case study, a variety of data collection techniques were used to gain understanding of the views, opinions, actions and interactions of participants at their natural sites. The study was concerned with finding participants who can offer knowledgeable insights into the problem under investigation and as such, a purposive or judgemental sampling technique was employed to select participants from each school.

3.2.4.1 Population of the study

A population is defined by McMillan and Schumacher (2014:143) as a total group of cases or elements such as objects, human beings or events that satisfy specific chosen criteria and as such the results of the study can be generalised to all members of the group. Mertens (2015:52) stated that a population is a total group for which the results of a study apply and for which the results can be generalised even from a small group. However, Lune and Berg (2017:16) argued that in qualitative research studies, generalisations of results to the population might not be easy.

The survey population of participating schools for this study consisted of all seven secondary schools located in the Highveld Ridge East Circuit. The Highveld Ridge East circuit was selected because the researcher has been teaching in one of the schools in that circuit since 2003 and as such, has witnessed poor performance of Grade 12 learners in mathematics over the years. The names of the secondary schools in the population and their mathematics pass rates for the past five years (2016 to 2020) are shown on Table 3.1:

Table 3.1: Survey population of schools and their Mathematics pass rates for 5 years

NAME OF SCHOOL	MATHEMATICS PASS RATES (In %)				
	2020	2019	2018	2017	2016
School A✓	57.6	44,9	43,2	53,0	79,0
School B✓	43.8	44,4	78,1	45,0	39,0
School C✓	35.5	24,0	18,8	8,0	35,0
School D	100,0	100,0	100,0	100,0	100,0
School E	84,0	66,7	90,3	56,0	74,0
School F	64.9	75,0	78,4	69,0	86,0
School G	57.4	98,1	59,5	59,0	82,0

(Source: DBE, 2016 -2020. National Senior Certificate: School Subject Report. Pretoria)

3.2.4.2 Sampling Technique

McMillan and Schumacher (2014:143) defined a sample as a group of participants from which data is collected. There are several sampling techniques that can be applied in qualitative research studies. There were two layers of sampling in this study. The first layer consisted of selecting the sites or schools and the second was selecting participants within each site or school.

McMillan and Schumacher (2014:371) highlighted that a clear definition of the criteria used to select a site should be provided and such criteria should be appropriate for the research problem. When selecting participants, Jason and Glenwick (2016:15) stated that naturalistic, purposive and snowball sampling techniques are usually applied to access target populations in qualitative inquiries. Under the naturalistic technique, the researcher collects data from participants in the natural setting whereas in purposive sampling, the researcher approaches participants based on their unique characteristics such as knowledge, expertise and experience. In snowball sampling, informants and participants suggest other participants to be included (Mishra & Alok, 2017:9).

In this study, an intense case sampling technique was employed to select the three schools from a total of seven schools in Highveld Ridge East Circuit. Under the intense case sampling technique, cases which are dramatic but not extreme are chosen like below average students, below average or underperforming schools (McMillan & Schumacher (2014:350). The objective of this study was to explore factors that impact

the collective management process of mathematics teaching and learning in the Highveld Ridge East Circuit focusing mainly on factors affecting performance of Grade 12 learners in mathematics. As a result, the three schools chosen have consistently underperformed in mathematics with pass rates below 60% in at least three of the last five consecutive years from 2016 to 2020, hence intensive case sampling technique was adopted.

In light of intense case sampling and purposive sampling techniques, the participating schools in the sample were chosen based on the definition of underperformance in the South African context. According to Louw *et al.* (2011:1) and Bayat *et al.* (2014:41) underperformance can be defined as achieving a pass rate below 60%. This relates specifically to all schools in the Highveld Ridge East Circuit that obtained a mathematics pass rate of 60% or below in three of the five consecutive periods from 2016 to 2020. Using this criteria, three schools were selected from the survey population. The schools to be included are shown in Table 3.2 below:

Table 3.2: Selected sample of schools in Highveld Ridge East Circuit

NAME OF SCHOOL	CIRCUIT
School A	Highveld Ridge East
School B	Highveld Ridge East
School C	Highveld Ridge East

(Source: Own construction)

In order to select participants in each school, purposive or judgemental sampling technique. According to Cohen *et al*. (2018:214) purposive sampling involves researchers handpicking cases or participants to be included in the sample on the basis of the cases or participants' typicality or their possession of the particular characteristics being sought. In other words, the researcher selects a sample that enables him/her to answer research questions and meet research objectives (Saunders *et al*., 2019:237). McMillan and Schumacher (2014:352) went further to explain that the participants in the sample are selected because they are able to offer the best information to address the problem as they should possess the knowledge and expertise to provide the best possible insights to the research study.

Participants from each school site consisted of principals, members of the school management teams (SMTs) who were preferably departmental heads responsible for mathematics and parents who were preferably members of the school governing bodies (SGBs). These participants were selected because of their in-depth knowledge of the factors that affect the collective management process of mathematics teaching and learning and hence influence academic performance of learners from homes, to school environments as well as the general system and policy environment using a purposive sampling technique, as defined by Saunders *et al*. (2019:39).Principals and heads of departments responsible for mathematics possess in-depth knowledge about school-based factors whereas parents possess in-depth knowledge about parental and social level factors that affect the collective management process of mathematics teaching and learning and hence influence performance of learners in mathematics. The list of participants and the factors they are expected to provide is summarised on Table 3.3 below.

Table 3.3: Summary of total participants and specific research objectives

PARTICIPANTS		INSTRUMENTS	OBJECTIVES
Classification	**Number**		
Parents	3	Interviews	▪ Parental and social level factors
Principals	3	Interviews	▪ School level factors ▪ System and policy level factors
SMT members	3	Interviews	▪ School level factors

(Source: Own construction)

3.2.5 Data Collection

This study employed in-depth interviews, non-participant observations and document analysis to collect data from participants, classrooms and documents at the three schools in the case study. A researcher can use an instrument or test such as a questionnaire or an interview question sheet to collect data or can gather information by observing behaviour of participants through observations (Creswell & Creswell, 2018:18). Several data collection techniques can be applied in a case study, largely in combination, and these techniques include questionnaires, interviews, observations, artefact and document analysis (Saunders *et al.,* 2019:198; McMillan and Schumacher, 2014:342).

3.2.5.1 In-depth interviews

An interview was defined by Saunders *et al*. (2019:434) as a purposeful discussion between two or more people. There are mainly three categories of interviews which are structured interviews, semi-structured interviews and unstructured or in-depth interviews (Saunders *et al.,* 2019:435; McMillan & Schumacher, 2014:381). An in-depth interview has been defined as a technique designed and used to elicit a vivid picture of the participant's perspective on the research topic and is used to pose open-ended questions and follow-up probes in order to gain an in-depth understanding of participants' experiences, perceptions, opinions, feelings, and knowledge about certain topic(s) (McMillan & Schumacher, 2014:382; Rosenthal, 2016:510). Edwards and Holland (2013:3) outlined the core attributes of qualitative in-depth interviews as an interactional exchange of dialogue between two or more individuals either face-to-face or using other means; thematic, topic-centred, biographical or narrative approach where the researcher brings topics, themes or issues they wish to cover in a fluid and flexible but not rigid manner; contextual knowledge where the researcher pays attention to context in constructing meaning and understanding of events and phenomena.

This study employed in-depth interviews as the main data collection instrument guided by pre-prepared interview protocols because these would enable the researcher to elicit more information from the participants in order to gain greater understanding of the factors affecting the collective management process of mathematics teaching and learning and hence influencing Grade 12 learner performance in mathematics. These interviews were conducted with school principals, departmental heads responsible for mathematics and selected parents. The interview protocols for principals, departmental heads responsible for mathematics and parents are presented in Appendices I, J and K respectively.

The main advantage of qualitative in-depth interviews is that they are targeted and focus directly on the questions that can answer the research questions and they are more insightful in that the researcher can drill down for more causal inferences from the interviewee (Yin, 2018:86). When conducting face-to-face, in-depth interviews the researcher/interviewer has an opportunity to ask follow-up questions for clarification and to notice other non-verbal and emotion cues exhibited by the participants

(McMillan & Schumacher, 2014:382). Rossetto (2014:483) highlighted the healing-meaning making function of in-depth interviews wherein the researcher gains and the participants get healing by having somebody to speak to in a cathartic manner. As such, these interviews would provide the participants with the opportunity to also air issues that are challenging them in their work and possibly feel healed from such an exercise.

Creswell (2014:311) outlined that when using interviews as a data collection instrument, a number of steps need to be taken into consideration. These include selection of interviewees (participants), determining the type of interview that is most appropriate and practical, ensuring the use of adequate recording procedures, choosing the most appropriate interview protocols as well as refining the interview questions and procedures.

The interview planning for this study involved identifying information needed from the research objectives, identifying participants as well as satisfying ethical requirements for conducting interviews. Interview protocols comprising open-ended questions, as espoused by Yin (2018:383) and Rosenthal (2016:510), were designed prior to the interviews for each group of participants comprising principals, departmental heads for mathematics and parents. The purpose of interview protocols was to ensure that the same thematic approach was applied to all similar participants, as advised by Qu and Dumay (2011:246).

Another important aspect of interview planning is on the logistics of the interview processes. McMillan and Schumacher (2014:385) highlighted five core contingencies for interview preparation and logistics and these are duration or length of each interview session; number of separate interviews required to collect the data; settings or location of the interviews; identities and number of participants in each interview; and informant styles or communication styles of participants. In this study, in-depth interviews conducted used a face-to-face format with all interview participants with each interview session lasting for between an hour to one hour and thirty minutes.

Rosenthal (2016:512) further underscored the need to properly record the proceedings of the interview processes while at the same time taking notes sparingly to minimise distracting the participants Data from interviews can be collected by making handwritten notes, by audiotaping, or by videotaping so that verbatim accounts of what

transpired during the interview processes are captured. (Creswell and Creswell, 2018:271,360). In this study, interview proceedings were recorded using audiotape recorders and the researcher took handwritten notes during the interview processes which allowed the researcher to rephrase questions and probes to obtain more information as well as allowing for recording of nonverbal cues that might assist in data analysis.

Edwards and Holland (2013:43) suggested that face-to-face interviews be conducted in a space that is convenient and accessible to both the participant and interviewer where there are no interruptions and there is sufficient provision for sound recording of the conversation. The venues were offices that were provided by the principals and departmental heads responsible for mathematics and were believed to be conducive for interviews in this study. The summary of in-depth interview participants for each school in the sample is provided in Table 3.4 below.

Table 3.4: Participants for in-depth interviews

NAME OF SCHOOL	PARTICIPANTS		
	Parents/SGB	**Principals**	**SMT Member**
School A	1	1	1
School B	1	1	1
School C	1	1	1
TOTAL	**3**	**3**	**3**

(Source: Own construction)

3.2.5.2 Non-participant observations

Yin (2018:382) and McMillan and Schumacher (2014:376) defined an observation as an instrument that allows the researcher to see what occurs naturally in the research field. The researcher can take notes, videos or pictures for further analysis. An observation involves the systematic observation, recording, description, analysis and interpretation of people's behaviour. According to Saunders *et al*. (2019:), there are mainly two types of observations, namely structured observations as well as qualitative observations. This study employed non-participant observations where the researcher did not participate in classroom activities but was merely an observer.

In non-participant observations, a researcher/observer is a complete outsider who only observes without taking part in the activities of the group being observed (Cohen et al., 2018:385). As such, non-participant observation consists of observing events,

behaviours, human actions and interactions as well as artefacts in a social setting without the researcher interacting with people and objects in the setting (Saunders et al., 2019:383).

This study adopted non-participant observations so as to enable the researcher to gather first-hand information about the atmosphere, ambience, interactions as well as other non-verbal cues that cannot be condensed by mere writing or speaking. A pre-prepared observation protocol which allowed the researcher to record field notes was used. In this study, one non-participant observation was done in one Grade 12 mathematics classroom at each of the three schools in the study sample. In total, three observations were conducted for this case study. Grade 12 mathematics classrooms were believed to be the most appropriate for observing classroom and other school-based factors that affect the collective management process of mathematics teaching and learning and hence influence performance in mathematics and also were access was possible to obtain. The observation protocol employed in this study is attached as Appendix L.

Observations, specifically non-participants observations were chosen as a data collection instrument, as advised by Mack *et al*. (2005:13), as there is mostly a difference between what people believe and say against their behaviour, actions and reality. Therefore, the main advantage of non-participant observations in this study was allowing the researcher to see and gather a rich picture of what happens, and therefore gain an understanding of the physical, social, cultural, and economic contexts in which participants teach and learn, rather than merely depending on what participants say (Mack *et al*., 2005:14). Another advantage of observations is that they enable the collection of data on non-verbal behaviour in natural and contrived settings (Cohen *et al*., 2018:397). However, despite their several advantages, observations suffer weaknesses which include suffering from selectivity unless a broad coverage is adopted and also the events may unfold in a different manner from the usual course because the subjects are aware that they are being observed (Yin, 2018:138).

Cohen *et al*. (2018:386) emphasised the need for self-reflection when undertaking observations to reflect on the methods used to collect the data, ethical issues, problems, tensions and dilemmas that arise at the observation site, the reaction, attitude and emotions of the observer to events as they unfold during the observation

periods. Ultimately one observation per selected class was conducted at one school for all the three schools in the sample, totalling three (3) observations. The researcher collected data by way of field notes using the designed observation grid/protocol, as shown on Appendix L.

McMillan and Schumacher (2014:376) added that one of the aspects to include in the observations is consideration of where the scene or group is located so as to capture aspects such as: physical settings, form and contexts; natural and technological resources that are used or created; allocation and use of space and objects; as well as lighting, sights, sounds, smells, tastes, emotions and feelings found in the observation contexts. Mack *et al*. (2005:13) advise that the chosen setting should enable capturing of sufficient details to address the research problem. Yin (2018:135) highlighted the importance of selecting events, scenes, places or groups where the researcher is able to gain access.

McMillan and Schumacher (2014:378) explained that one of the considerations when conducting observations is to determine *"who is in the group or scene?"*. Participants in all three classroom observations at all three schools were learners and teachers during normal mathematics classes as ordinarily conducted at selected schools in the case study. These participants are critical to the teaching and learning and therefore performance in mathematics.

Yin (2018:136) underscored the importance of being at the right place at the right time. Mack *et al*. (2005:19) further pointed out that the specific times of conducting observations depend on when particular activity(ies) usually take place, like when Grade 12 mathematics lessons are conducted at particular schools. Consequently, for this study, morning mathematics lessons were chosen before lunch break to capture the period when both learners and teachers still have energy and concentration.

3.2.5.3 Document analysis

Document analysis is defined by Bowen (2009:27) as a systematic procedure used for evaluation and reviewing of documents both in print and electronic formats with a view to gain meaning, understanding and generating empirical knowledge. Documents are classified under artefacts and there are basically two types of documents that can used in qualitative research, which are personal documents and official documents

(McMillan & Schumacher, 2014:368). Documents can contain text (words and numbers) and images, which were recorded without the involvement of the researcher (Bowen, 2009:27). There are a number of document types which include letters, memoranda and other communiques; administrative documents such as proposals, progress reports and other internal reports; organisational records such as organisational charts and budgets over a period of time; lists of names and other relevant items; as well as personal records such as diaries, calendars and telephone listings, agendas, attendance registers, minutes of meetings, books, manuals, background papers, brochures, advertisements, maps and charts, newspaper articles, event programs, legal documents and organisational or institutional reports (Yin, 2018:128), all of which can be analysed.

In this study, document analysis was conducted mainly for corroborating other two types of data collection instruments. Specifically, policy document analysis was preferred because educational policy documents are easy and free to retrieve without challenges of access or ethical issues bordering on privacy and confidentiality. Educational policy documents are readily available from various websites of credible organisations such as government departments and agencies. The specific policy documents analysed in this study were The Constitution of the Republic of South Africa, Act No. 108 of 1996, South African Schools Act, Act No. 84 of 1996, National Education Policy Act, Act No. 27 of 1996, Employment of Educators Act, Act No. 76 of 1998, Terms and Conditions of Employment of Educators, Language in Education Policy of 1997 and National Curriculum Statement (NCS) Curriculum and Assessment Policy Statement – Mathematics FET Phase Grades 10-12.

Bowen (2009:28) outlined that the rationale for using document analysis is mainly for the purpose of double-checking evidence obtained from various other methods, a process called triangulation. Triangulation typically encompasses corroborating evidence from different sources or methods in order to gain a deeper understanding on a theme or perspective. The main advantage of conducting document analysis is that there is little interaction between the researcher and the participants or subjects (McMillan & Schumacher, 2014:34). Other advantages of document analysis include stability such that the documents can be reviewed repeatedly; exactness to the extent that they contain exact names, references and details of events; lack of obtrusiveness and reactivity such that the documents were not created for the purpose of the study

and there is minimum interface between the researcher and participants; broad coverage spanning a long period of time, various events and settings thereby allowing the researcher to identify trends and changes in patterns and again, document analysis is cost effective (Bowen, 2009:31).

However, document analysis suffers from weaknesses too. Cohen *et al*. (2018:326) argued that whereas in certain sections of society there is a rich document culture where there is a comprehensive documentation for the phenomena being researched, there are some sections where there is inadequate documentation for any meaningful analysis. Other disadvantages, as cited by Yin (2018:129), are that access to documents may be denied and, in some instances, the retrievability is low with most important documents missing. Eventually the study was confined to policy document analysis where the documents freely accessible and retrievable without privacy restrictions.

Linton *et al.* (2019:3) highlighted that the first stage in document analysis is determining and sampling/selecting the documents that are relevant to answering the study's research questions. In this study, documents were purposefully selected to address issues under school level and policy and system level factors that form part of the central questions and objectives of this study, which include learner and teacher absenteeism, mathematics teachers' recruitment and qualifications, language of teaching and learning. Bowen (2009:32) explained that the process of conducting document analysis encompasses skimming, reading and interpretation of selected and available documents. This process involves organising information into categories relevant to the central research questions (content analysis) and also establishing patterns within the data that form themes relevant for further analysis (thematic analysis) (Linton *et al*., 2019:3).

Under content analysis, policy documents such as policy on teacher qualifications, teacher employment, language of learning and teaching were used to address system and policy level factors. In undertaking document analysis, the researcher should take reasonable care to ascertain various aspects such as the original purpose of the document and its target audience, information about the composer of the document as well as the original sources of the information (Bowen, 2009:33).

3.2.6 Data Analysis

In this study, data analysis consisted mainly of three phases which were data transcription where data collected during the collection phase were transcribed into concise written verbatim transcripts, data coding where codes were assigned to different data sets and subsets in all the verbatim transcripts, as well as data categorisation and analysis where similarly coded items were grouped and meanings were established and the process repeated until deeper meanings were established. All phases of data analysis were done at home in order to preserve the integrity of the data as well as participants.

McMillan and Schumacher (2014:395) defined qualitative data analysis as an inductive process used to organise data into categories in order to establish relationships and patterns among such categories. In qualitative studies, data analysis is conducted during and after data collection and gathering which makes the process of data analysis an ongoing one. In other words, data collection and data analysis are intertwined. Qualitative data analysis is a sequential process with several related steps ranging from specific to general. These steps include organising and preparation of data for analysis; segregating data into general ideas and themes; coding of data into segments; describing data; representing description and themes and finally establishing patterns and interpretation (Creswell & Creswell, 2018:275-277). According Saunders *et al*. (2019:482) qualitative data is based on meanings expressed through words and its collection is non-standardised, therefore requiring classification into categories. Furthermore, the analysis of qualitative data is done through conceptualisation.

3.2.6.1 Data Transcription

Data transcription is part of data preparation and organisation (Saunders *et al*., 2019:466). Data transcription was defined by McMillan and Schumacher (2014:398) as a process of converting notes taken during observation and interviews, audiotape recordings and visual images into a format that facilitate further analysis. For interview and field notes, the researcher takes brief notes during the interviews or observations which have to be expended immediately, preferably 30 minutes to an hour, after the interviews or observations. Audiotape recordings are transcribed into writing through computer typing. The typing of such audiotape transcription has to be done in a

manner that would allow for analysis. Cohen *et al*. (2018:523) warned that transcriptions inevitably result in data loss from the original encounter and this problem is compounded in transcriptions that involve translating data from one set of rule systems - oral and interpersonal - to another very remote rule system like written language.

Data from interview notes and audiotape recordings were transcribed into written and typed verbatim transcripts using MSWord within three days of the interviews. Field notes and reflexive records recorded from non-participant observations were also transcribed into written and typed verbatim transcripts using MS Word within a day of the observations. Finally, summary points from policy document analysis were transcribed into verbatim transcripts using MS Word within a day of the document analysis. For ensuring integrity, confidentiality and non-disclosure of participant records, all data transcription exercises were done at home and all source materials were kept locked away.

3.2.6.2 Data Coding

Saldaña (2009:4) explained that coding can be understood as a transitional process between data collection and more extensive data analysis. Stake (2010:151) went on to describe coding as sorting of data sets according to main topics, themes, and issues important to the study. This sorting of data can be formulated based on research questions, concept maps, or clusters of patches developing. Additionally, McMillan and Schumacher (2014:399) outlined that data coding begins with the researcher sorting small pieces of data that stand alone into segments that divide the dataset. Each segment contains one idea, episode or any other piece of important information and can be a single word, one sentence or a few lines of texts or even several pages. A qualitative researcher can start coding earlier in the research study or it can be done at a later stage when most of the data have been collected. The categories of coding are progressively developed and focused as the research question takes on new meanings and as the fieldwork develops new concepts and inter-relationships (Stake, 2010:151). The starting main themes and concepts centre of parental and social level factors, school-based factors as well as system and policy-induced factors that affect the collective management process of mathematics teaching and learning and hence impacting on learner performance in mathematics.

After all data were transcribed into verbatim transcripts, the researcher reflected on each paragraph to establish meanings and assign appropriate codes for each. Saldaña (2009:4) explained that coding has two phases, the first one is decoding where a researcher reflects on a passage of data to establish its core meaning and the second one. which is encoding where the researcher assigns codes to paragraphs. The initial codes were formulated from initial research questions as well as the main factors that were identified in literature studies as well as well as the theoretical framework. Recurring themes and codes were identified and collated to establish patterns among different codes identified from the data sets. The patterns were established as the data were segregated, grouped, regrouped and relinked to consolidate meaning and explanations.

3.2.6.3 Description of Data and Themes

McMillan and Schumacher (2014:404) stated that data codes established during the coding process are used to establish categories or themes which represent major ideas that are used to describe the meaning of similarly coded data. Saldaña (2009:8) further explained that coding is a method which enables a researcher "to organize and group similarly coded data into categories or 'families' because they share some characteristic – the beginning of a pattern". Description of data encompasses rendering meaning to the setting, participants, places and events that took place in the data collection setting. Such categorisation of data codes into themes is important in attaching detailed descriptions for case studies normally encoded into five to seven themes that form the major sections in the findings of the study (Creswell & Creswell, 2018:275).

In this study, data sets with similar codes were grouped together into data categories to establish meanings along each recurring code or category. This enabled the researcher to establish major themes arising from individual categories or groups of categories. The above process was repeated when the researcher recoded and reclassified the data to explore deeper meaning from various codes and categories. The main themes and sub-themes that were employed in this study emerged from the research questions and from literature review. The major themes expected to emerge at this stage in this study revolve around parental and social factors, school specific factors as well as system and policy related factors that affect the collective

management process of mathematics teaching and learning and hence influence performance of Grade 12 learners in mathematics in secondary schools around the Highveld Ridge East Circuit.

3.3 MEASURES FOR TRUSTWORTHINESS

Five major strategies were employed throughout this study to enhance trustworthiness and these are triangulation which involved using multiple data sources and examining evidence from the sources and using it to build a coherent justification for themes; member checking where parts of the interpretations were taken back to participants to check whether the researcher's interpretations converged with what the participants presented; clarifying bias where the researcher relied mainly on reflex records after each field experiences that were in-depth interviews, non-participant observations as well as document analysis, providing rich, thick descriptions for all findings in order to capture in-depth meanings and alternative interpretations and peer debriefing where the researcher used a colleague who is an expert consultant in dissertation and business consultancy. Other techniques that were less intensely used throughout the study include presenting negative or discrepant information and prolonged time in the field sites in order to gain more insights.

McMillan and Schumacher (2014:119) reflected that trustworthiness of data, results, findings and the integrity of the whole study should be consistently checked at each stage of field experience and in reflexive records. In essence, trustworthiness can be thought of as the ways in which qualitative researchers ensure that their studies produce results which are a truthful representation of what the studies intended to explore. Creswell and Creswell (2018:282) stated that other terms such as validity, authenticity and credibility can be used to address the attribute of trustworthiness. This attribute of trustworthiness encompasses that study results can be transferable, credible, dependable, valid and reliable (McMillan & Schumacher, 2014:120). Saldaña (2009:28) advised that for lone researchers, trustworthiness can be enhanced by checking preliminary interpretations with the participants themselves (member checking) and maintaining a reflective journals and copious analytic memos on all data collection and field activities.

3.3.1 Credibility

Credibility has been defined by McMillan and Schumacher (2014:119) to mean the extent to which research results approximate reality. Credibility may be enhanced when the research design can identify possible sources of errors and bias that can undermine the quality of the research such that reasonable steps can be taken to avoid or minimise the impact of such errors or bias on the results, findings and conclusions derived from the study. Additionally, Saunders *et al*. (2019:251) further posited that the aspect of credibility needs to minimise the possibility of a study producing wrong answers to the research questions. Creswell and Creswell (2018:282) pointed out that researchers need to convey all procedures they follow in carrying out their studies to ensure accuracy and credibility of their interpretations and findings. Creswell (2014:300) further explained that credibility of data and findings can be enhanced by obtaining trust at the field site so that the responses and data obtained truthfully capture the true opinions, views and expressions of the participants.

Lune and Berg (2017:196) advised that one of the ways of ensuring credibility is by explaining clearly the methods used in the study and then following those methods precisely as explained. Additionally, Creswell and Clark (2018:432) provided other ways of ensuring credibility as triangulation of different data sources, resolving disconfirming evidence, thick description of the research process, member checking as well as auditing by research advisors. In this study, data from interviews were triangulated with data from observations and document analysis. Furthermore, a thick description of the research process was provided mainly on the research methods used and the data presentation. Finally, all the work was reviewed by the study supervisor and feedback was processed accordingly so as to keep the focus on the study objectives.

3.3.2 Dependability or Reliability

Overall, dependability or reliability in this study was ensured by documenting the procedures of the multisite case study as well as documenting as many of the steps of the methods and procedures as possible. At the data collection phase, dependability was ensured by sending all interview protocols and questions, observation protocol and the document analysis guide to two independent peers to ascertain whether they addressed the research objectives of the study. Two pilot interviews were conducted

with two independent peers to ascertain whether the questions were understandable and answerable. During the data analysis phase, dependability was ensured by debugging all verbatim transcripts for obvious errors that might have occurred during data transcription phase and by making sure that there was consistency in the definition of codes throughout the coding process. This was ensured by composing memos of definitions of codes. Another measure that ensured dependability in this study was to ensure speedy and accurate transcription of data. Field and interview notes and audiotape recordings were transcribed within three days of the interviews. Observation notes were transcribed within a day of the observation. Document analysis drafts were transcribed within a day.

Creswell and Creswell (2018:282) explained that qualitative reliability indicates that the researcher's approach should be consistent across different researchers and among different projects. Stake (2010:118) further explained that for a study to be dependable, researchers should prepare evidence and ensure the understanding for users of research, the practitioners and administrators and policy makers. As such, users of research studies should act with caution and wait for confidence in the dependability of research studies. To enhance reliability of the data collection instruments, McMillan and Schumacher (2014:383) advised that pilot interviews should be conducted to test aspects of the interview process on issues of whether respondents are comfortable with questions or whether they fully understand them as well as to determine the approximate length of the actual interviews. Cohen *et al*. (2018:246) explained that the terms dependability and reliability can be used synonymously and such attributes can be enhanced by identifying acceptable procedures of carrying out the research inquiry so as to ensure that the results and the data conform to each other.

3.3.3 Confirmability

Confirmability was ensured by adopting research methods and instruments that have been consistently applied by scholars in the field of poor performance in mathematics in South Africa. This study used structured research instruments that were applied consistently for all similar respondents from different schools and for all observations in different schools. Each group of participants (principals, departmental heads and parents) had a uniform interview protocol and all classroom observations had a similar

observation protocol that was used for all observations. All the responses of the face-to-face interviews were audiotape recorded and kept safely in lockable drawers at the researcher's home. All the data collection instruments – interview protocols, observation protocols and document analysis guide – were sent to a peer who is an expert in academic research and business consultancy. Each chapter was also sent to the peer as well as the supervisor to check for confirmability of the research to epistemological guidelines of qualitative educational research. Triangulation was also employed to enhance confirmability.

The attribute of confirmability entails that research findings should be able to be confirmed to the extent that a different researcher, repeating the study under similar conditions, methods and participants, should also obtain similar results. This quality is also referred to as verifiability (McMillan & Schumacher, 2014:49). Creswell & Creswell (2018:204) argued that qualitative researchers seek more confirmability than objectivity and it is mainly achieved through auditing of the whole research process to ensure that it conforms to epistemological guidelines of the relevant research inquiry. Stake (2010:123) further stated that confirmability can also be enhanced by triangulation.

3.3.4 Transferability

This aspect of transferability implies that the methods, instruments, results and findings from a study can be used or inferred in different contexts. The aspect of transferability in this study was enhanced by logically laying out the research process as well as description of the phenomenon under research. Creswell & Clark (2018:285) argued that to generalise a case study's findings in a new case setting, the researcher needs to provide good documentation of qualitative procedures that were applied, such as a protocol for documenting the problem in detail and the development of a thorough case study database. This study was a multisite case study where similar observation protocols for observations at all three schools. Similar interview protocols were used for similar participants at each of the three schools and the data were analysed to come up with common themes that describe such common factors that affect the collective management process of mathematics teaching and learning and hence influencing performance of Grade 12 learners in mathematics at those schools. As such, the findings can be transferable to different settings and similar conclusions

be deduced. Cohen et al (2018:76) further argued that research findings should also be transferable between the researcher and those being studied and for that to be ensured, thick description of the research processes is required.

Cohen et al (2018:76) described transferability as a quality of research study that enables the reader to apply information obtained from the study to other settings and circumstances. This attribute can be enhanced by providing detailed description of all the steps involved in the research study such that readers can identify shared characteristics. Creswell and Creswell (2018:285) posited that the concept of transferability or generalisation is applied in a limited way in qualitative research since the intent is not to generalise phenomena but to provide particular descriptions and themes. However, they further provided case studies as exceptions where findings from one case can be transferred or applied in new cases. Stake (2010:184) further cautioned that in order to make generalisations, qualitative researchers need to make inquiries and observations in diverse and multiple situations.

3.4 ETHICAL MEASURES

In undertaking qualitative studies in educational research, it is imperative for the researcher to understand his/her ethical and legal responsibilities since such studies involve dealing with human beings. As a result, most studies have to be approved by Institutional Review Boards before such studies are undertaken (McMillan & Schumacher, 2014:129). Generally ethical issues require that the research design and methods should not expose participants to embarrassment, harm or any other material disadvantage (Saunders *et al*., 2019:257).

The major ethical issues discussed in this section are full disclosure and deception; informed consent; voluntary participation; confidentiality; anonymity; and prevention of harm or risk to participants.

For all research studies undertaken by UNISA postgraduate students, ethical clearance was obtained from UNISA Research Ethics Committee to conduct the research. An ethical clearance form was obtained, completed and signed by a research student before the research could be carried out. The Ethical Clearance Certificate is attached as Appendix B. Furthermore, written permission was obtained from the Provincial Director of Education responsible for Knowledge Management and

Research, director of Gert Sibande Region, Circuit Manager of Highveld Ridge East Circuit as well as principals of the schools concerned. The permission request letters are attached on Appendices D, E and F respectively. This research study was for academic purposes only and at no point did researcher disclose methods, sources and findings of this research to third parties. Additionally, the identity of participants was kept anonymous and their responses confidential.

3.4.1 Gaining permission to conduct study

Cohen et al (2018:124) stressed that it is an ethical obligation for the researcher to obtain permission from gatekeepers to conduct research studies within the premises controlled by such gatekeepers. Creswell and Clark (2018:235) further articulated that gaining access to people and sites requires the researcher to obtain permission from individuals in charge of those sites and there may be many such individuals along the hierarchy of an organisation. For this study, permission was sought from Mpumalanga Provincial Department of Education, Gert Sibande District Department of Education as well as the Highveld Ridge East Circuit. The letters requesting permission from these offices are attached as Appendices D, E and F. The permission to conduct the study was confirmed by the Circuit Manager responsible for Highveld Ridge East Circuit and is also attached as Appendix C.

3.4.2 Informed Consent

To address the issue of informed consent at the stage of gaining access to research sites and participants, letters seeking permission to conduct research at each of the three schools in the case study were sent to gatekeepers who are the circuit managers and school principals. Creswell (2014:102) stressed the need for having permission to gain access to sites or individuals from human subjects' ethics review boards. In return, the gatekeepers were asked to sign permission forms. At the stage of data collection using interviews, all interviewees were sent and asked to sign consent forms that explain the purpose and scope of the study and their role in participating in the study before the interviews could be carried out. For observations, the dates and times when observations would be conducted were agreed upon with the principals, departmental heads responsible for mathematics, as well as teachers of mathematics at the particular school where the observations were carried out.

The ethical requirement for informed consent stipulates that subjects or participants should agree to participate in the research with full knowledge of the aims and purposes of the study (McMillan & Schumacher, 2014:130). Stake (2010:204) went even further to suggest that qualitative researchers should not only obtain informed consent but that such consenting should be anonymised as well. Cohen *et al*. (2018:122) went further to clarify that informed consent implies informed refusal. The ethical requirement of informed consent arises in the stages of gaining access to research sites and during data collection (Saunders *et al*., 2019:258).

3.4.3 Voluntary Participation

Voluntary participation in this study was evidenced by signed permission forms from circuit managers and principals for access to schools, permission and consent forms from principals and departmental heads as well as consent forms from teachers of mathematics for conducting observations in classrooms. For interviews all participants were required to sign consent forms (See Appendix H). Before interviews commenced, the researcher once again reminded the participants of the right to voluntary participation and that they can withdraw totally or partially in the interview process. The researcher further explained that the participants were not expected to gain anything financial by participating in the study.

Voluntary participation prescribes that participants should not be compelled, coerced or required to participate in a study (McMillan & Schumacher, 2014:130). In addition, Cohen *et al*. (2018:117) asserted that voluntarism entails applying the same principles as with informed consent by ensuring that participants freely choose to take part (or not) in the study and provide guarantees that exposure to risks willingly, knowingly and voluntarily undertaken. Saunders *et al*. (2019:258) further stressed that when interviewing participants, informed consent should be evidenced and supported by a more detailed written agreement, such as a consent form signed by both parties. The consent form used for participants in this study is attached on Appendix H.

3.4.4 Confidentiality

Confidentiality requires that the identities of participants should not be divulged to unauthorised persons and that when such disclosure to third parties becomes necessary, express consent of participants is required (Cohen et al., 2018:128). The

stationery, equipment and all other materials bearing identities of participants were physically kept secure throughout data collection, analysis and findings. All the electronic devices used in this research, a laptop and smartphone, are password protected and all physical papers were always be kept in lockable drawers both at the researcher's home and no material was taken to the workplace. In presenting data analysis and findings, the names of participants and schools were not disclosed and all documentation with names and identities of participants and schools were strictly not available to third parties. In describing participant responses, only keys were used for which a memo of those keys was designed and kept confidential. The final readers of the research study will therefore not be able to link any responses to individual participants.

Stake (2010:207) summarised confidentiality as the need for a researcher to avoid soliciting for private information that is not directly related to the study being pursued. The confidentiality requirement of ethical consideration prescribes that access to individual data and/or names of participants should be restricted only to the researcher and that all information would be solely used for the purpose of that study. Cohen *et al*. (2018:128) emphasised the need for non-traceability of responses to participants which encompasses aggregating data in some cases so that individual's responses are not detectable. McMillan and Schumacher (2014:134) further assert that confidentiality means that only the researcher should have access to data and names of participants and also that the participants should be made aware of all individuals who would have access to their data before they participate. Creswell and Creswell (2018:499) stressed that a guarantee for confidentiality should also be included on the informed consent form to be signed by all participants. One way of enhancing confidentiality is by ensuring that data and information cannot be linked to participants by name and also by ensuring that the materials like papers and electronic devices that contain the data and names are kept physically and electronically secure (McMillan & Schumacher, 2014:134).

3.4.5 Anonymity

In this study, anonymity was enhanced by avoiding using identities of participants or any information on interview notes, audio recordings and on verbatim transcriptions. The identities of participants were limited to a memo that provided keys for each school

site as well as the individual participants at those schools. Additionally, in data analysis and presentation of findings, the identities of participants and schools were not mentioned by their names but by using keys linked to such participants and schools.

McMillan and Schumacher (2014:134) explain anonymity as not being able to identify the participants from the data or information gathered. In other words, the researcher should not be able to identify who said or did what from the information gathered and recorded. Although anonymity is not easy to achieve between the researcher and the participant in face-to-face interviews, there are several methods that can be used to enhance it for third parties and readers of research findings which include use of keys instead of real identities (Cohen *et al*., 2018:129). Creswell and Creswell (2018:499) posited that in qualitative research anonymity/privacy of participants can be achieved by using aliases or pseudonyms for people and places, to protect the real identities of participants. However, Stake (2010:207) argued that anonymity is a weak protection and as such, the main way to protect a person's privacy is avoiding knowing private matters.

3.4.6 Harm or Risk to Participants

Although there were no apparent risks of harm to participants, the researcher assessed the circumstances surrounding each individual participant and took all reasonable steps to avoid any danger befalling any of the participants. Further to that, the UNISA Research Ethics Committee outlines the parameters under which student researchers conduct their studies. Among other requirements is the need to keep all details of participants confidential, the need to prevent loss of life of participants and also to avoid undue stress and anxiety on the participants.

It is an ethical requirement that research should not expose participants to any form or risk of danger whether physical, mental or psychological. This danger encompasses risk of injury, harassment and punishment, negative impacts on school performance, societal standing, home life or friendships (McMillan & Schumacher, 2014:127). Saunders *et al*. (2019:257) further asserted that avoidance of harm or non-maleficence is generally viewed as the cornerstone of ethical issues that confront those who undertake research. This is so because the way the researcher obtains consent, preserves confidentiality, collects data from participants and the way in which data is used, analysed and reported, all have the potential to cause harm to participants.

There is a tension between the society's belief of the value of free scientific inquiry and knowledge and the belief in the dignity of individuals and their rights to considerations that follow. Therefore, there is a need for a delicate balance between the two extremes (Cohen *et al*., 2018:127). Creswell & Clark (2018:233) asserted that in the event that potential harms are foreseeable, the consent form should contain an explicit statement about known risks anticipated in participation in the study.

3.5 SUMMARY

The objective of this study was to establish factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics in secondary schools in the Highveld Ridge East Circuit. This chapter provided the research design and methods that were used to undertake this study in order to achieve the above objective. This study followed a constructivist/interpretivist research paradigm and therefore adopts a qualitative research design and approach. The study was a multisite case study involving three schools in the Highveld Ridge East Circuit in the Gert Sibande District of Mpumalanga province. The schools were selected using an intense case sampling technique using final matric performance in mathematics over the past successive years from 2016 to 2020. Participants from each school were selected using purposive sampling technique based on their perceived knowledge pertinent to answering research questions. Data were collected by means of in-depth interviews using open-ended questions with school principals, departmental heads responsible for mathematics as well as parents at each of the selected schools. Additionally, an observation of one normal mathematics classes at each school was conducted. These two data collection methods were supplemented by analysis of supporting documents for certain aspects. Data from interviews were collected using field notes and audiotape recordings, data from observations and document analysis were collected using handwritten field notes. The interview and field notes were expanded and transcribed into typed verbatim transcripts in MS Word within three days after such interviews and within one day after field observations and document analysis. The research ethics of this study were ensured by way of full disclosure and deception, informed consent, voluntary participation, anonymity and confidentiality of participants as well as avoidance of minimising of harm or risk to participants.

CHAPTER 4: DATA ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

In the previous chapter, the research design and methodology for the study and their justification were outlined. In short, the study followed a case study research design which falls under qualitative research approach as guided by the interpretivist/constructivist research paradigm. The primary characteristics of this type of research is that data is in narrative rather than numerical format, data are analysed using an inductive approach and there are multiple realities or interpretations that can be attached to the meaning of the data (McMillan & Schumacher, 2014:17).

In this chapter, an analysis and interpretation of the data collected is presented. This research study intended to answer the research questions that were laid out in Chapter 1. The main research question for this study was posed as *What factors affect the collective management process of mathematics teaching and learning in the Highveld Ridge East Circuit in the Gert Sibande Region of Mpumalanga, South Africa?*

The subsidiary research questions were framed as:

1. What parental and social level factors affect the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?
2. Which school level factors influence the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?
3. How do system and policy level factors affect the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?
4. How does technology impact on the collective management process of mathematics teaching and learning and performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?

In order to answer the above questions, a qualitative research approach was adopted and a multisite case study research type was followed. A sample of three (3) from seven (7) secondary schools in the Highveld Ridge East Circuit were selected and

from each school in-depth interviews were conducted with the school principal, departmental head responsible for mathematics and one parent of a Grade 12 learner at that school. Additionally, one non-participant observation and document analysis were conducted at each of the three schools. This chapter is arranged as research process first, followed by detailed data analysis and interpretation. Under data analysis, biographic data as well as data collected from research instruments is presented and analysed systematically.

4.2 RESEARCH PROCESS

Subsequent to the formulation of research questions and the devising of the appropriate methodology, data were collected. Before the data could be collected, ethical clearance was sought and obtained from UNISA College of Education (UNISA CEDU). In order to gain access to research sites and participants, permissions to conduct research in the three schools were sought and obtained from Mpumalanga Provincial Department of Education (MPEDU), Gert Sibande District Education Department, the Highveld Ridge East Circuit as well as from the three principals at each of the three schools in the sample. Three qualitative data collection techniques were applied to collect the data and these were structured in-depth interviews, non-participant observations and document analysis.

4.2.1 In-Depth Interviews

In-depth interviews were employed as the main data collection technique in this study. Face-to-face in-depth interviews were planned with the principal, departmental head responsible for mathematics and one parent of a Grade 12 mathematics learner at each of the three schools in the sample. The interviews for principals and parents went as planned with all of them being conducted accordingly. However, only two interviews with departmental heads were conducted instead of the planned three. In aggregate, eight of the nine planned interviews were successfully conducted. Three interviews were conducted with principals in their offices, three interviews were conducted with parents at places that were convenient to them, and two with departmental heads responsible for mathematics at places that were convenient to them. All the interviews were audiotape recorded and participants were informed prior to the start of the interviews.

In order to ensure informed consent and voluntary participation, covering letters which contained all the relevant information concerning the interviews were sent to the participants at the time the researcher was making appointments for the interview dates and times. Additionally, before the start of each interview, the researcher read the covering letter to the participant to explain the purpose of the study as well as all ethical issues concerned. The participants were given an opportunity to ask questions if they needed clarity on any matter concerning the interviews.

In face of the COVID-19 pandemic, all social distancing protocols as stipulated by the National Department of Health (NDoH), National Department of Basic Education (DBE) and the guidelines of the UNISA Covid-19 position statement on research ethics were strictly adhered to for the interviews. For all interviews, there were no other threats of physical, emotional and psychological harm or malfeasance on participants. To ensure anonymity, the names and identities of the schools and the respective participants were not mentioned anywhere in this research report. The schools were referenced as School A, School B and School C. The participants were also referenced in relation to the school to which they belong (for example School A Participant 1 or School B Participant 2 or School C Participant 3).

4.2.2 Non-Participant Observations

At each of the three schools in the sample, one non-participant observation was conducted in a normal Grade 12 mathematics classroom as ordinarily conducted at that school. In total, three non-participant observations were conducted in this study. For all the observations, permission was granted by the school principal and departmental head responsible for mathematics. Consent was also obtained from the mathematics teacher. All COVID-19 prevention protocols and social distancing guidelines were strictly adhered to by leaners, the teacher and the researcher. No physical, emotional and psychological harm was experienced in all the observations. As with face-to-face interviews, all other ethical guidelines were satisfied during the conduct of non-participant observations.

4.2.3 Document Analysis

As planned, document analysis was conducted. The documents that were analysed were policy documents in form of Acts of Parliament and national educational policies. These documents were downloaded from the Department of Basic Education website

and are available in the public domain. As such, there were no ethical issues that arose in the collection of the documents.

4.3 BIOGRAPHICAL INFORMATION

The biographical information of the eight interview participants can be summarised in Table 4.1 below:

Table 4.1: Participant biodata

School	Participant	Gender	Age Category	Educational Level	Teaching Experience
School A	1	Female	61-65 years	Honour's Degree	+ five years
School A	2	Male	41-60 years	Bachelor Degree	+ five years
School A	3	Female	41-60 years	Teaching Diploma	N/A
School B	4	Male	41-60 years	Bachelor's Degree	+ five years
School B	5	Male	41-60 years	National Diploma	N/a
School C	6	Male	41-60 years	Honour's Degree	+ five years
School C	7	Female	41-60 years	Honour's Degree	+ five years
School C	8	Female	20-40years	Below Matric	N/A
A; B; C	**NPO	Female	41-60 years	Honour's Degree	+ five years

NOTE: **NPO is the researcher who was a non-participant observer at Schools A; B: and C.

As indicated in Table 4.1 above, all the principals and departmental heads who were interviewed were aged above 40 years and all have more than 20 years of experience as school principals. All principals and departmental heads held bachelor's degrees and above. All parents interviewed were above 35 years old. There was also gender balance among participants with four females and four males representing a 50:50 gender balance.

4.4 DATA ANALYSIS AND INTERPRETATION

In this subsection, the data collected is analysed and interpreted. The data were coded and classified into different themes and sub-themes that were informed by the research questions and objectives and were subsequently synthesised in the literature review and theoretical framework. Data were collected using in-depth interviews and non-participant observations. Interviews data were recorded by notes taken during the

interviews and full audiotape recordings and non-participant observations data were recorded as field notes on a pre-planned observation protocol. Data from the in-depth interviews were transcribed verbatim on Microsoft Word.

Qualitative content analysis was primarily used as the data analysis technique. Cohen *et al.* (2018:668) explained content analysis as a technique for systematically coding many words of texts and organising them into fewer categories. Saunders *et al*. (2019:574) outlined the principles that a researcher should observe in order to ensure that content analysis is done in a systematic manner. These principles were followed in this study and these are: linking the analysis to the study's purpose, research questions and objectives.

- Being exhaustive to the extent that all components of the data can possibly be fitted into categories.
- Ensuring that each component of data only fits into a single category.
- Ensuring that independent components of data that may be related but not similar be placed into different categories.
- Ensuring that the analysis derive from classification to avoid conceptual confusion.

An analytic coding style was adopted for this study since it could allow the researcher to interpret the data deeply and ascribe more meaning to it than simply describing the data. Cohen *et al.* (2018:671) highlighted that analytic coding may stem from the theme or topic of the literature or from the data itself. The coding used for this study was guided by the research questions posed in Chapter 1 and further restated at the beginning of this chapter. Firstly, the segments of the data were assigned analytic codes following the principles above. These codes were then grouped into main and sub-categories which relate to themes and sub-themes as derived from the research questions, research objectives, literature review and theoretical framework. The themes emerged from research questions and objectives that were set out for this study whereas the sub-themes were synthesised from the literature review and theoretical framework. The themes and sub-themes that emerged from this study are summarised on Table 4.2 below.

Table 4.2: Themes and sub-themes that emerged from the data

	Themes	Sub-themes
1	Parental and social level factors	1. Parental involvement in the education of their children 2. Income levels and social status of parents and caregivers 3. Learners' characteristics, motivation and attitudes towards mathematics 4. Parental control over their children 5. General state of neighbourhoods and social environment
2	School level factors	1. Safety and security around school environment 2. Truancy, late-coming and absenteeism 3. Teachers' quality, content knowledge and experience 4. Teacher-learner relationships 5. State of classroom infrastructure 6. Availability of teaching and learning materials 7. Teachers' workloads, syllabus length and completion
3	System and policy level factors	1. Foundational knowledge and mathematics skills from lower grades 2. Grade promotion policy and practice 3. Using English as language of learning and teaching
4	Technological factors	1. Inappropriate use of modern-day technologies

4.4.1 Theme 1: Parental and social level factors

Parental and social level factors are those conditions that emanate from family characteristics and societal attributes that affect the collective management process of mathematics teaching and learning and hence impact on the performance of learners in their school work in general and in mathematics in particular. From the literature review and theoretical framework, several factors were identified and these include: parental involvement in the education of their children; income and social status of parents and caregivers; household status and family characteristics; learners' attitudes towards the subject of mathematics; parental control over their children and the general state of the neighbourhoods and social environment.

4.4.1.1 Sub-theme 1: Parental involvement in the education of their children

One of the factors that emerged under parental and social level theme was parental involvement in the education as regards to checking the children's school work, encouraging and ensuring that their children do their homework, liaising with mathematics teachers and attending parents' meetings. Asked how they were involved in the education of their children in terms of checking homework, liaising with teachers and attending parents' meetings, all these parents highlighted that they were to some extent involved in the education of their children. Participant 3 of School A replied as:

> *"I normally do [liaise] with the subject teachers because I don't know maths and as I said, I also liaise with the tutors who are helping my child so that I can check the performance in every subject especially mathematics."* (P3, SA)

The above response points to the fact that Participant 3 liaised with mathematics teachers and privately arranged tutors because the parent herself lacked knowledge of mathematics to offer direct assistance to the child.

Parents also highlighted that they attend meetings when they are called. Participant 5 of School B stated that:

> *"... And then I also do attend parents' meetings when they call for them in school." (P5, SB)*

The results from the data collected in this study revealed that parents were, to some extent, involved in the education of their children by checking the school work of their children and also attending, or sending proxies to attend parents' meetings when they are called. Additionally, parents reported that they also liaise with mathematics teachers or tutors about the performance of their children.

The Bronfenbrenner (1979, 2006) bioecological model of human development highlighted the importance of close and sustained interactions between the learner and the immediate environment, in this case the home environment, in influencing the progress of the learner. This finding seems to suggest that for the schools studied parental involvement was not a major obstacle in the performance of learners in mathematics, since parents were involved in the education of their children is consistent with the microsystem and proximal processes specifications of the bioecological model. However, the finding contradicted Mji and Makgato (2006:261) as well as Makgato (2007:98), who found that inadequate parental involvement in the education of their children contributes to poor performance of learners in mathematics. Gniewosz and Watt (2017:1380) went even further to identify that it is not only the assistance that parents give to their children in mathematics at home but more importantly, the beliefs and views of parents and teachers in learners' mathematical abilities that play a major role in stimulating interest and enhancing the development of intrinsic mathematical skills.

4.4.1.2 Sub-theme 2: Income levels and social status of parents and caregivers

Another factor that emerged from parental and social level theme was income levels and social status of parents and caregivers. This aspect impacts on the ability of parents and caregivers to provide extra-school assistance to their children such as extra tuition, extra study resources, textbooks, technology such as laptops, tablets and data as well as assisting their children with their homework in mathematics. The researcher posed a question to establish the kinds of assistance that participants offered to their children as regards to their study of mathematics.

Participant 8 of School C replied that she organised a study group for her child to interact with other learners in community and also bought a laptop and study guides and mobile data for the child. The response was:

> *"I made him to meet a study group with other local boys who are performing well at your school and other surrounding schools… it's me who initiated that study group…. He also uses data to search for information and he has a laptop… I buy him study guides for mathematics, I also buy him data so that he can search whatever information he wants from the internet. I started buying him data and study guides when he was in grade 11."* (P8, SC)

The assistance that parents offer to their children was, however, limited because some of the parents do not have knowledge of mathematics to assist their children with homework and other tasks, but finds alternate ways of helping and supporting their children with mathematica. Participant 3 of School A stated that:

> *"… Because I as parent, I don't know maths, I usually look for tutors who would come and help him. I pay for that and also the school has organised extra classes for them."* (P3, SA)

The response of Participant 3 above indicated the willingness of parents to assist their children in their education but that assistance was not direct since the parent might not be in possession of mathematics knowledge. As such, the best they could do was to outsource the services of privately arranged tutors who probably would not be always there when the children needed help or assistance in mathematics.

From the data presented above, it appears that some parents lacked knowledge of mathematics which meant that they could not themselves offer assistance directly to their children. However, parents were able to assist them in their studies, and could afford to offer various forms of assistance to their children such as organising tutors for mathematics, organising study groups and tutorials for their children outside school, providing their children with other resources such as laptops, data and study groups.

This study, therefore, could not sufficiently determine whether or not income levels and social status of parents and caregivers impacted on Grade 12 learners' performance in mathematics. Findings by Udida *et al.* (2012:135), Sinyosi (2015:54) and Mlachila and Moeletsi (2019:24) established that learners from high income families tend to perform better than learners from low-income families. This is because learners from high income families are able to source and afford more educational and cultural resources and they can afford to attend private tutorials. Although this study established that generally parents offer assistance and extra resources to their children, the greatest challenge was parents' lack of knowledge of mathematics and/or formal education to sufficiently assist their children with the subject content of mathematics. This was consistent with findings by Sinyosi (2015:51-52) who established that parents who are semi-illiterate and illiterate in mathematics cannot effectively assist their children in areas in which they are struggling.

4.4.1.3 Sub-theme 3: Learners' characters, motivation and attitudes towards mathematics

Learners' characters, motivation and attitudes towards mathematics also emerged as a sub-theme under parental and social level factors. Various responses were obtained from respondents. Departmental heads of mathematics, seemed to concur that learners lacked interest in mathematics and therefore did not sufficiently study on their own.

Participant 2 of School A believed that the learners lack the motivation to work independently since they need to be guided in mathematics and as such they do not study without some form of support and assistance:

> *"Uhmm, uhmm, from our side, yes, we do give quality activities but the challenge with mathematics is they [learners] need a person who is always next to them,*

that is the main challenge with mathematics, unlike other learning areas, they can study themselves but with mathematics that is a serious challenge because otherwise you know our learners, they learn wrong concepts or wrong methods…" (P2, SA)

This view of lack of motivation and a negative attitude to mathematics was corroborated by Participant 7 of School C who said:

"[the challenges] Is the poor learner interest in the subject as some still believe in the myth that the subject is difficult, they seem not to study daily, or practise mathematics daily but only prepare a day before they write a test or examination." (P7, SC)

On the other hand, parents of Grade 12 mathematics learners believed that their children are motivated and can work on their own. When asked to describe their children's attitudes towards school work, behaviour, characters and level of motivation,

Participant 3 of School A responded as:

"I can say he has a positive attitude of school. He has a positive attitude of schoolwork at home. Because always I found him trying to study on his own at home… Ehh for motivation, he is motivated, is a person who wants to achieve high, he has a positive self-talk, that is why he wants to repeat grade 12 if he passes maths and physics with a level 6 because his goal is to pass them with level 7." (P3, SA)

Participant 8 of School C concurred and stressed that:

"He does his school work; I don't have to force him to do his school work at home. He is motivated, he wants to become a doctor, that's why he chose maths and science." (P8, SC)

These responses suggested that some learners were generally motivated and had positive attitudes towards school work in general and as such, they did study on their own. However, the challenge might have been that even if they were studying mathematics independently, there was the risk of them not understanding and needing support and assistance.

Classroom observations seemed to point towards general lack of confidence and interest during the classroom sessions. During non-participant observation at School A, the researcher (NPO) noted:

> *"…some learners appeared cheeky and always checking their time for break since the lesson was towards break time. Some learners showed interest in the subject while some appeared to be uninterested. Some learners showed interest in the subject while some appeared to be in a wrong class" (NPO, SA).*

In the classroom at School C, the researcher recorded that:

> *"… the class was not interactive with the teacher dominating the proceedings and learners being passive" (NPO, SC).*

This study therefore established that generally learners were motivated to study but there were some groups of learners who lacked interest in the subject of mathematics and therefore did not study the subject on their own. One of the tenets of the Bronfenbrenner (1979, 2006) bioecological model of human development is 'the person', which stresses the role of the personal characteristics of the developing person in influencing the progress of development. In this study, it appeared that the learners lack interest in mathematics and have a negative attitude towards the subject, which was demonstrated in their behaviour during classroom observation. This finding is consistent with Sinyosi (2015:54) who established that generally most learners lack interest in mathematics and were not willing or eager to study the subject on their own. Other learners viewed mathematics as a difficult subject which requires more time than that available and therefore have negative attitudes towards the subject. These attitudes and characters could possibly have a adverse impact on learners' performance in mathematics in Grade 12. This finding was line with Rankhumise (2019:99) and Naidoo and Kapofu (2020:1) who discovered that learners' negative attitudes impact their performance in mathematics.

4.4.1.4 Sub-theme 4: Parental control over their children

Parental control over their children is a key ingredient to the behaviour and discipline of children at home, at school and in the society in general. Generally, such behaviour and discipline determine success, or lack thereof, of such children in all spheres of life. This aspect also emerged as a sub-theme in this study. Generally, parents of Grade

12 mathematics learners, bemoaned minimal levels of parental control over their children. Asked about their views of the general level of parental control over their school going children, Participant 3 of School A had this to say:

> "*And as for the general society, I could say it's [parental control] not so good. Some of the parents are at work, they leave early when they go to work, not realising that after they have left early, they have left their kids do not go to school, that is when you see them complain about or at a later stage a parent to find that after leaving a child did not go to school for the whole of the quarter. And that becomes a very serious problem in our society as a whole, parents because of the work, because of the challenges of working, they are unable to control the attendance of their children in a good way."* (P3, SA)

Participant 5 of School B felt that some parents do not even know what is happening in their children's lives as a result of many things like lack of time to monitor their children's behaviour, ignorance as well as lack of proper education. This was supported by the following response:

> "*But some parents don't even know what's happening in their children's lives. They just take their children to school and then they will come in December to collect reports. That's it…. the reason might be, I think ignorance and maybe not having time, not making time for assisting their children also I think that [lack of education] can be the [other] reason, some parents did say they didn't finish school, and you will find that maybe the homework(s) that they give the learners are hard for them to assist the learners."* (P5, SB)

Participant 2 of School A, who was a departmental head for mathematics, corroborated parents' views on lack of parental control over their children. Part of the response was:

> *"…they (learners) are not monitored by parents because the parents they leave before our learners leave for school, so there is no monitoring, that is one of the reasons [of late coming and absenteeism], so we are trying to find a solution to this one…"* (P2, SA)

Generally, the data collected seemed to point to lack of sufficient parental control and monitoring of children's behaviour such as attendance of school. There appears to be

a number of causes of minimal levels of parental control and monitoring such as parents' work and other commitments, parents not taking or having enough time to check and monitor their children, ignorance and lack of proper education of parents.

Parental control also falls within the microsystem and proximal processes of the Bronfenbrenner (1979, 2006) bioecological model of human development which influences the development of the learners. In terms of policy, the National Education Policy Act (1996:12;20) stipulates that parents have an obligation to ensure that their children attend school regularly and the ultimate responsibility for the behaviour of learners lies with parents, who are also expected to attend parents' meetings convened by the school governing bodies. Generally, the finding that some parents do not exert sufficient control and monitoring over the behaviour of their children such as consistently monitoring attendance of their children because of pressures of work and other commitments, which makes it difficult for parents to track the behaviour of their children, spending most of the time at work, leaving home early and coming back late. This aligns with Heeralal and Dhurumraj (2016:314) who discovered that most parents are working and most of them do not have or do not make time to assist their children hence they perform poorly in mathematics.

4.4.1.5 Sub-theme 5: General state of neighbourhoods and social environment

The beliefs, associations and general views of children and hence their performance at school, is to some extent influenced by the neighbourhoods in which they reside. This factor also emerged in this study. Asked on their state of neighbourhoods in terms of conduciveness for learning and other issues like exposure to substance abuse, parents of Grade 12 mathematics learners concurred that the neighbourhoods were not conducive for proper learning and studying especially with regards to mathematics, as reported Participant 3 of School A:

> *"Yoh!, The exposure is very bad, is not conducive, there is a high level of substance abuse, both drugs and alcohol. And there is a lot of crime in our vicinity where you are even afraid of sending your child to go to the shop to buy something because so many things, bad things, are happening to them, especially the boys. And most of the boys in our vicinity are involved in drugs. Most of them are drinking alcohol, and that is so unmanageable. It's really a challenge that if you don't look at your child, can be affected easily."* (P3, SA)

The response by Participant 3 signifies how the context of the neighbourhoods with exposure to crime, drug and alcohol abuse, affects the learning and studying of children. The extent is such that parents even fear for the safety of their children when they are outside home because of social problems such as crime, drug and alcohol abuse. Such an environment cannot be conducive for the study of mathematics and therefore can have a negative impact on the performance of Grade 12 learners in mathematics.

Participant 5 of School B added the list of other negative societal exposures and said:

> *"I can say it is not good. Many learners are easily exposed to drug abuse. And that contributes to absenteeism from school, teenage pregnancy and dropping out of school, which adds to the increase in crime."* (P5, SB)

The Taylor and Baker (2006) theory of learning performance highlighted the influence of the social environment on the learners' motivation and eventual effort in school work. This study found that the general state of the neighbourhoods was not safe for children and the problems experienced in them could result in affecting the learning and studying process for learners. This state was a result of negative social vices such as alcohol and drug abuse, crime and teenage pregnancy which tend to cause issues such as absenteeism, drug dependency, alcoholism and dropping out of school. As such, the study of mathematics is negatively affected which might cause poor performance in mathematics.

The finding in the paragraph above, is supported by Heeralal and Dhurumraj (2016:310) who revealed that the parental and social background of learners including the state of neighbourhoods they come from have a significant bearing on learners' performance in physical sciences, and therefore also in mathematics.

4.4.2 Theme 2: School Level Factors

A second major theme that arose in the data analysis of this study related to school level factors. These are conditions and attributes that emanate from the school environment and for which the school management can exert significant influence. As such, these factors manifest themselves differently from one school to the other. The major informants for this theme were principals and departmental heads responsible for mathematics since they were believed to be more informed about their schools'

environments. These factors include: safety and security around the school environment; truancy, late-coming and absenteeism; teachers' quality, content knowledge and experience; teacher-learner relationship; state of classroom infrastructure; availability of teaching and learning materials; and length and non-completion of syllabus.

4.4.2.1 Sub-theme 1: Safety and security around the school environment

Teaching and learning classrooms tend to be influenced by the general conditions in the school environment. Main conditions centre on the feelings of educators, learners and non-educator staff over their safety and security whilst inside the school environment. This aspect emerged during data analysis for this study.

Asked about safety and security precaution measures at school, principals were generally of the belief that there are adequate security measures around their school premises. Participant 4 of School B stated that there were no major safety and security issues around the school environment except minor learner conflicts which were manageable. The response was codified as:

> *"There is no safety threat, there is no security threat, we have not have any major burglaries in our school, we have never have had a major threat from outside the school…[…inaudible background noise]…of course we have incidents of learners fighting here and there but it is not a major issue, it has always been minor incidents normal for school learners that are always handled...we don't have gangsters and so on…"* (P4, SB)

It can be construed that the response above pointed to adequate safety and security measures around school environments for the schools except for minor clashes among learners. As such, it can be deduced that safety and security around school environment was not among factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of learners in mathematics based on the findings from the schools in case study.

The school governing body (SGB) is tasked by the South African Schools Act (1996:12) to adopt a code of conduct for learners, educators and other staff within and around the school environment so as to create a disciplined and conducive

environment for learning and teaching and advance the quality of teaching and learning. The finding that safety and security might probably not be one of the factors that affect the collective management process of mathematics teaching and learning in School B particularly and hence contribute to poor performance. However, Louw *et al.* (2011:70) found that low safety and security around the school environment could negatively impact learners' performance in mathematics, which may be the case in the other schools.

4.4.2.2 Sub-theme 2: Truancy, late coming and absenteeism

Truancy, late coming and absenteeism make learners miss valuable teaching time and learning due to missed lessons. This aspect also arose during data analysis of this study. Asked to describe the pattern of absenteeism for their children, parents of grade 12 learners believed that learners sometimes absent themselves from school with Participant 3 suggesting though that the pattern is not consistent:

> *"The pattern is not, as I have observed, it is not consistent. Sometimes my child he is attending and sometimes not. It is like he does not understand the importance of attending regularly."* (P3, SA)

On the other hand, asked to comment on late coming and absenteeism of learners and teachers of mathematics, departmental heads for mathematics concurred that late coming was prevalent but there were factors to consider. Participant 2 had this to say:

> *"Yeah, late coming it's a challenge, we still need to address that challenge… late coming is still a challenge. Yea, there are other factors, you know those social factors, one of the reasons is maybe one day there is no electricity, and other factors, or there is no water and on top of that one"* (P2, SA)

Participant 7 of School C agreed with the above and had this to say:

> *"…the absenteeism is at a very alarming rate as they blame the municipality for power outages and they cannot use hot water to bath due to the power cuts … learners are always coming late to school especially in winter."* (P7, SC)

Of concern is … *"Teachers, they also come late… they also come late."* (P2, SA)

Participant 2 reported that the issue of absenteeism has been partly resolved:

"…the absenteeism is controlled nowadays, before the absenteeism was very common but now, I think after we introduced this nutrition programme and all, I think the learners they are not absenting themselves, they are coming regularly" (P2, SA).

During non-participant observation, absenteeism and/or late coming was observed at two schools.

"Number of learners present in School A mathematics class observed was 45 (for which 26 were male and 19 were female) against a total class enrolment of 51 learners. Six (6) learners were either late or absent." (NPO, SA)

"Number of learners present in School C mathematics class observed was 20 (for which 9 were male and 11 were female) against a total class enrolment of 31 learners. Eleven (11) learners were either late or absent." (NPO, SC)

These observations indicated a late coming and absenteeism rate of 12% for School A mathematics class and 35% for School C mathematics. These are high rates indicated that, if that is the usual norm, late coming and absenteeism were still prevalent and would have a major effect on the teaching and learning process of mathematics.

Taylor and Baker's (2006) theory of learning performance highlighted the interplay between the societal environment and the academic environment, mainly the influence of the family, community and culture on the learners' attitude and motivation towards school work. This finding of absenteeism and late coming thus indicated such interplay. The reasons for the late coming absenteeism revolved around home situations like power outages, water supply cuts and lack of proper parental monitoring. From the data, it can be deduced that late coming for learners and teachers was still prevalent in schools studied and to some extent, absenteeism was also still prevalent although in some cases, absenteeism was now controlled in one of the schools.

This late coming and absenteeism created gaps in the learning of mathematics content and teachers were hard pressed to ensure that these gaps were closed so that learners were well prepared for examinations. Mathematics by its nature requires that learners should attend classes regularly so that they do not miss concepts that are

presented in class. As such it can be inferred that late coming and absenteeism in mathematics classes are among factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor performance of Grade 12 learners in mathematics.

At policy level, the South African Schools Act (1996:6) provides for compulsory attendance of school for all learners from the age of seven years until fifteen years or until Grade 9, whichever comes first. It is the responsibility of the parent or caregiver to support and ensure such attendance (National Education Policy Act, 1996:12). The findings above are supported by Masitsa (2004:229) and Mlachila and Moeletsi (2019:32) who discovered that there are still high rates of absenteeism and late-coming especially on Mondays, Fridays and month ends. The behaviour of late-coming and absenteeism is driven by truancy which is manifested in learners' disobeying school authority and therefore coming late and leaving during the school day and in some instances, absenting themselves for a couple of days or even weeks.

4.4.2.3 Sub-theme 3: Teachers' quality, content knowledge and experience

The quality, content knowledge and experience of mathematics teachers is assumed to play an important role in the overall performance of learners in the subject. This is another aspect that emerged as a sub-theme in the analysis of data for this study. Asked about the level of experience and qualifications for mathematics teachers, departmental heads for mathematics, concurred that mathematics teachers in their schools were qualified and are differently experienced. Participant 2 said:

> *"Teachers are qualified, they are all qualified… [in terms of experience] Some are experienced, some have more than five years and some have less than three years. Some are more experienced than the others. Some [the newly appointed educators] are from Funza Kushaka, but they are also qualified."* (P2, SA)

Responding to a question about teachers' content knowledge, Participant 2 believed that mathematics teachers do have content knowledge but they lacked depth and confidence and some of the teachers are not willing to teach higher grades beyond Grades 9 or 10. This was deduced from the following response:

> *"From my experience, yes they do have content [but ummh], but the depth, in terms of depth, I cannot guarantee that, that's why I cannot put all teachers to be*

in Grade 12, some they do not want to go beyond Grade 10 or Grade 9, they want to go up to Grade 8 and Grade 9, some they want to go up to Grade 10, so beyond that level, they don't want to go, uhmm that confidence, that confidence, is a lacking factor for them in order to go up to Grade 12 [interjection – they are still lacking] yeah." (P2, SA)

Responding to a question about the quality of newly graduated teachers in terms of content knowledge and methods of instructions, principals, differed in their opinions on the issues. Participant 1 opined that newly graduated teachers struggle with methods of instruction and classroom management. The response was given as:

"We have realised that the newly graduated maths teachers are impatient to slow learners, they also do not have enough teaching experience and they struggle when they start teaching in the day-to-day school environment" (P1, SA).

Participant 4 believed that newly graduated teachers possess content knowledge but they are lacking in methods of instruction and classroom management techniques. The response from this participant was:

"Content yes. The only thing that overwhelms new graduated teachers is that they find an environment that is not strict, it's difficult for them to keep discipline with the type of learners - like if the learners experienced a lot, it's very difficult for them to bring them back… the second thing is method of instruction to say strategies and approaches, to say how I deal with struggling learners? How do I deal with unruly learners in class?" (P4, SB)

Asked about the skills and attributes that they look for when recruiting mathematics teachers, Participants 1 of School A; 4 of School B and 6 of School C, who were all principals, gave varying responses. Participant 1 replied as:

"The skills required include team teaching, collaborative teaching with other teachers and learners' motivation to instil the love and zeal of mathematics as well as resource materials… [as for the attributes] we check previous credentials and results of that particular teacher so that we make sure we are hiring a teacher who will bring results to the school, to the circuit as well as to the learners themselves." (P1, SA)

The response above reflects that teachers who are hired should be skilled and should be innovative so as to instil interest in the learners. Additionally, the teachers should be qualified to teach mathematics as evidenced by the teachers' certificates.

Participant 6 emphasised on the need to hire teachers who are committed, innovative and can motivate and instil the interest of mathematics in learner. His response was:

> *"Firstly commitment, the teacher must be committed, the teacher must be innovative as well because if you teach maths [and] if learners do not understand you, you need always to change, the way you teach maths, you need to also to make the learners to love the subject, I think that can helpful [to make] the learners love maths as a subject [and that it is not] so hard and can help them to settle well in the industry."* (P6, SC)

On the academic environment of the Taylor and Baker (2006) theory of learning performance, the qualities of the teachers are encapsulated under the 'instructor'. The qualities of the instructor affect everything that goes on in the classroom. From the data presented in the paragraphs above, it can be construed that schools hire mathematics teachers who are qualified with good academic records. Nowadays they recruit newly qualified teachers from the Funza Lushaka bursary scheme who have degrees. Furthermore, schools look for committed and innovative mathematics teachers who can motivate learners and instil an interest of mathematics in learners.

The levels of experience of teachers differ from school to school. Inexperienced and newly graduated mathematics teachers, though qualified and possessing content knowledge, seem to struggle with methods of instruction and classroom management techniques. Experienced teachers also seem to be suitably qualified with sufficient content knowledge but some lack depth and confidence to teach mathematics at higher grade levels. It can therefore be summarised that although mathematics teachers are qualified, possess content knowledge and are mostly experienced, the challenge lies in lack of depth, confidence, proper methods of instruction and classroom techniques. This challenge might be one of the factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics.

The National Education Policy Act (1996:47) articulated the seven roles of an educator which encompass mediating learning in a manner that identifies and eliminates barriers to learning and create an environment that inspires learners. The educator should also exude sufficient content knowledge of the subject matter to inspire confidence in the learners. From the findings above, as regards content knowledge of the subject matter, mathematics teachers are in line with the prescriptions of the National Education Policy Act (1996:47). However, these findings contradict those of Makofane and Maile (2019:43-45) who established poor content knowledge by mathematics teachers as one of the contributors of poor learner performance in mathematics. With regards to eliminating learning barriers as well as creating an environment that inspires and instils confidence in learners, the teachers are struggling, which is supported by those of George and Adu (2018:135) who discovered that lack of sufficient teaching strategies or the way in which educators of mathematics present the subject plays an important role in demoralising the learners and developing a negative attitude towards the subject.

4.4.2.4 Sub-theme 4: Teacher-learner relationships

A good relationship and interaction between teachers and learners create an environment conducive to teaching and learning. Such an environment engenders trust, respect and mutual understanding which leads to instilling interest and confidence in learners. During data analysis, this aspect emerged as a sub-theme in this research.

Responding to a question about the interactions between mathematics teachers and Grade 12 learners, departmental heads of mathematics, seem to concur that the interactions depend on the level of understanding of the learners. Participant 2 of School A thought that learners with an understanding of content tend to interact with the teachers whereas those who lack in content are hesitant. The reply was:

> *"Yeah, those who have substance they always interact, [interjection – yeah], those who[…uhm, uhmm] are not good in the subject, they are[…uhm uhm] hesitating to come forward with their questions."* (P2, SA)

Participant 7 concurred and replied as:

> *"Teacher-learner interaction is acceptable but, in some classes, learners seem not to have previous grade knowledge and will solely depend on the teacher feeding which makes them very inactive in participating."* (P7, SC)

Non-participant observations in the classrooms reflected harmonious relationships between teachers and learners, although learner participation was limited. The researcher observed that in the classroom at School A, the learners behaved well and there were minimal disruptions to the flow of the class and recorded as:

> *"The teacher and the learners interacted well. The classroom management was well with learners generally behaving with discipline but some learners appeared cheeky and always checking their time for break since the lesson was towards break time. The lesson was stable with the teacher exerting little measures to control learners' behaviour and learners showed respect and confidence in their teacher."* (NPO, SA)

A similar observation was recorded in the classroom at School B as:

> *"The learners appeared nervous at the beginning of the class but there were no irregular actions in the class with the learners behaving positively towards each other throughout the lesson. There was order in the classroom with the teacher using minimum measures to control the class, and the learners showing confidence in the teacher. At the beginning of the class, the teacher and learners appeared uncomfortable but they relaxed as the lesson progressed."* (NPO, SB)

Taylor and Baker's (2006) theory of learning performance clarified that the methods of instruction and the instructor play a significant role in influencing the presentation of the subjects and hence the relationship between the instructor and learners. This study established that teacher-learner relationships or interactions were satisfactory except that in some cases, where learners with little content or understanding of the subject seemed to lack confidence in asking and replying to questions in the classes. Although there were seemingly good relationships between mathematics teachers and learners, the challenge of learners lacking confidence to actively participate by asking and responding to questions, may limit their comprehension on mathematics concepts and therefore may impact negatively on their performance in mathematics.

The findings above are thus in tandem with the provision of the National Education Policy Act (1996:19) which states that learners should interact with each other and with educators and non-educator staff with mutual respect and respect of each other's rights and diverse views. Additionally, these aspects of teacher-learner relationships are predicated on the Porter and Lawler (1968) expectancy theory, which asserts that the instructor/learner relationship is one of the basic components that can influence learner performance in any field and in this case, mathematics. In simple terms, there should be a 'fit' between the qualities of the instructor, the methods of teaching employed, the subject itself and the quality of the learner (Taylor & Baker, 2006:385-386).

4.4.2.5 Sub-theme 5: State of classroom infrastructure

The state of classroom infrastructure plays a critical role in conditioning the mood and concentration of learners during mathematics lessons. If the classroom environment is not good and conducive to learning, learners and teachers are distracted and the process of teaching and learning is impaired. This state is influenced by factors such as availability and quality of desks and chairs, ventilation and lighting. This emerged as another aspect during data analysis for this study. There was general consensus among principals that there was adequate ventilation, lighting and furniture. Asked to describe the state of ventilation, lighting, desks and chairs, Participant 1 of School A responded as:

> *"We have adequate ventilation and lightning [lighting] though during the day we depend on [a] day light, we don't put on electricity bulbs if it's not necessary but all that have been provided for and is sufficient"* (P1, SA)

Participant 6 of School C explained that they made sure that Grade 12 learners are provided with sufficient desks and chairs. The reply from Participant 6 was as:

> *"The school has every year prepared to make sure that our Grade 12 learners have good furniture, adequate furniture but due to the fact that vandalism that I have already alluded to, sometimes our learners end up really being affected, because learners from other grades will come and poach or steal furniture that is meant for the Grade 12 learners."* (P6, SC)

Non-participant observations also revealed that there was adequate ventilation, lighting, desks and chairs in the three classroom that were observed in the schools in the case study. The researcher observed that a School A:

> *"The classroom at School A was standard sized with adequate desks and chairs for all learners who were present with adequate ventilation and lighting although there was no electricity. A normal chalkboard was used for teacher illustration with learners using textbooks and sharing study guides in pairs of two. Generally, the classroom was clean and conducive for teaching and learning."* (NPO, SA)

From the Taylor and Baker (2006) theory of learning performance, materials were listed as one of the tenets of the academic environment that affect learning performance. From the data above, it can be deduced that there was adequate ventilation and lighting in Grade 12 classrooms at schools studied. Additionally, in normal periods there were enough desks and chairs in the Grade 12 classrooms. It then follows that Grade 12 classrooms for the schools studied were in good state in terms of ventilation, lighting, desks and chairs. Therefore, this aspect may not be among factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor performance of Grade 12 learners in mathematics.

According to the South African Schools Act (1996:16), it is the responsibility of the school governing body (SGB) to administer, control, maintain and improve school infrastructure such buildings and grounds. From the above findings, it appears the schools' governing bodies for the schools studied were executing that responsibility. However, the above finding contrasted with findings by other scholars such as Louw *et al.* (2011:68) who established that bad state of classroom infrastructure such as poor ventilation, insufficient desks and chairs, poor state of such desks and chairs, poor lighting, small and overcrowded classrooms all have a negative impact on learners' performance in mathematics.

4.4.2.6 Sub-theme 6: Availability of teaching and learning materials

Teaching and learning materials play an important role in the performance of learners in mathematics since non-availability of such materials can impair the learners' studying patterns. During data analysis of this study, the aspect of availability and

quality of teaching and learning materials emerged as a sub-theme under school related factors. During the interviews, principals and departmental heads of mathematics concurred that there were not enough teaching and learning materials for Grade 12 mathematics learners. The response from Participant 1 was:

> *"You need to remember that the materials which are being supplied to the schools and those which are being purchased to reach the schools are not enough for all the learners and by so doing, the schools are having challenges when it comes to teaching the children without enough textbooks and remember that our schools are under Section 21 no fee-paying schools … we cannot be able to add more books for the learners so that each and every learner can have their own books"* (P7, SC)

From the response above, it can be seen that teaching and learning materials supplied to the school were inadequate thereby causing challenges in teaching and learning of mathematics as learners have to share the available materials. This challenge was exacerbated during the COVID-19 pandemic period since learners needed to be physically separated in class and at times remained at home.

Participant 4 of School B shared a similar view and responded as:

> *"Textbook shortage at this school is one of the major causes of failure because the learners don't have enough textbooks." (P4, SB)*

Participant 6 added a similar comment:

> *"they [textbooks] are not enough and some of them are not of good quality, so what the learners are learning from those textbooks they are not good guides to help our kids to even do maths and pass maths at the end of the day. So, there are not enough textbooks in terms of study guides, we do encourage the learners to help and parents also to help, the parents do sometimes supply but they are not enough, not enough to cover all the leaners, but they do supply not enough stationery and support material."* (P6, SC)

During non-participant observations, the researcher observed that in classrooms at School A and School C, learners were sharing textbooks and study guides for mathematics. This might point to a shortage of textbooks and learner guides.

Taylor and Baker's (2006) theory of learning performance listed learning materials as one of the elements in the school environment that influence learning performance. From the data presented in paragraphs above, it can be deduced that there was a shortage of mathematics teaching and learning materials for Grade 12 learners. Additionally, some of the materials provided were of poor quality and as such, they were not useful to learners and teachers. Despite some efforts by schools to put some interventions into place, the challenge still persists. The situation was exacerbated by the physical distancing requirements during the COVID-19 pandemic. It can therefore be construed that shortages of teaching and learning materials may be among factors affecting the collective management process of mathematics teaching and learning and hence contributing to the poor academic performance of Grade 12 learners in mathematics.

The South African Schools Act (1996:16) allocated a further function to the school governing bodies (SGBs) to purchase textbooks and other teaching and learning materials for the school. Despite efforts by schools to alleviate shortages of textbooks and study guides, these have not been sufficient. The findings above concurred with Mlachila and Moeletsi (2019:34), Heeralal and Dhurumraj (2016:312) as well as Rankhumise (2018:99), that shortage of textbooks, teaching and learning materials as well as shortage of library and laboratory facilities combine to negatively influence Grade 12 learners in mathematics.

4.4.2.7 Sub-theme 7: Teachers' workloads, syllabus length and completion

The workloads of mathematics teachers in terms of number of lessons per week and also in terms of class sizes, affect the concentration and motivation of teachers since large workloads might overwhelm them and they might fail to plan and execute the lessons successfully. The length of the mathematics syllabus also influences the amount of time available for instruction. If the syllabus is too long, it means there is less time for classroom instruction which can lead to non-completion before examinations are written. There was an agreement between departmental heads for mathematics, that teachers' workloads in terms of number of lessons were normal but in terms of class sizes, there was a challenge. Secondly, there were varying views on syllabus length and appropriateness. On teachers' workloads, Participant 2 responded as:

"It's normal, we have a mechanism, we try to balance after issuing the time table, almost, almost even [departmental heads] we do have periods less than a PL1 teacher but others might have slightly more periods than others, we try to balance but it's not perfectly balanced but it's okay." (P2, SA)

Participant 7's response was brief:

"The load percentage is according to policy; the challenge is the ratio 1:50." (P7, SC)

The responses above indicated that in terms of number of lessons, this is allocated according to policy prescriptions and is considered normal for mathematics teachers. However, there seems to be a challenge in terms of huge classes in contrast to the class sizes dictated by policy.

On the length and appropriateness of Grade 12 mathematics curriculum, Participant 2 replied:

"Yeah, actually they are not coping with that level of questioning, I think the reason is still us, it's still with us because in the lower grades actually we are not training them to do these level 3 or level 4 questions, mostly we are doing only level 1 or level 2 questions, then come Grade 12, you know that this paper is a standardised paper, all the world is standardised, UMALUSI is approved, so and they are preparing this paper for everyone not only for a certain group of learners that's why our learners are not coping with the standard of the paper." (P2, SA)

This response indicated that Grade 12 mathematics learners were failing to cope with the current syllabus, particularly developing the learners' ability to cope with the level of questioning expected at Grade 12 level. This deficiency seems to have resulted from a lack of foundational skills from lower grades.

Participant 7 believed that there was adequate curriculum coverage at the Grade 12 level although some topics might need to be rationalised. This was condensed in the following reply:

"Grade 12 curriculum is adequate, as most topics are done in Grade 11 but inverse function could be removed." (P7, SC)

Non-participant observations revealed the following teacher-learner ratios: 1:51; 1:48; and 1:31 for Schools A; B; and C respectively. It appears that Schools A and B had larger than normal class sizes which does not align with policy on class size and teacher-pupil ratio.

Presentation of material by teachers to learners in classrooms is one of the core elements of the Taylor and Baker (2006) theory of learning performance. The data presented above suggested that mathematics teachers had normal workloads in terms of number lessons as stipulated by policy; however, some of the Grade 12 classes had larger than normal class sizes in terms of teacher-learner ratios. The syllabus length seemed to be normal although learners are not coping and as such some topics might need to be rationalised. As a result, it can thus be submitted that larger than normal classes as well as syllabus depth, might be among factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor academic performance of Grade 12 learners in mathematics.

At policy level, the NCS CAPS document outlined ten content areas or main topics for mathematics at Further Education and Training (FET) Phase Grades 10-12 which should be completed before learners can write Grade 12 examinations (2011:9). As for stipulated teacher-to-learner ratios, the guidelines stipulate that the standard norm should be 1:40 for primary schools and 1:35 for secondary schools (DoE, 2009:66). The large number of learners in a class might overwhelm the teacher and present challenges in properly managing the class and diagnosing learning barriers for different groups of learners. This finding was consistent with Louw *et al.* (2011:69) and Bayat *et al.* (2014:49) who discovered that overcrowded classrooms are one of the factors contributing to poor performance of Grade 12 learners in mathematics because such overcrowded classes are difficult for teachers to control and monitor.

4.4.3 Theme 3: System and Policy Level Factors

Another theme that emerged in this study was system and policy level factors. These factors are conditions and confinements that are placed universally by policies, rules and regulations across all schools in South Africa or in Mpumalanga overall. These factors include foundational knowledge and mathematics skills from lower grades; language of learning and teaching (LoLT); and grade promotion policy and practice.

4.4.3.1 Sub-theme 1: Foundational knowledge and mathematical skills from lower grades

The aspect of foundational knowledge and mathematical skills from lower grades emerged in several interviews in this study by all groups of participants – parents, departmental heads for mathematics and principals. It generally follows that learners who reach Grade 12 without having acquired appropriate knowledge and skills in mathematics from lower grades, mostly struggle with the content and Grade 12 mathematics examinations.

Asked about the preparedness of learners in mathematics when they arrive in Grade 8 from primary schools, principals believed that learners arrive in Grade 8 lacking basic mathematics skills required for them to cope with the Grade 8 curriculum. Participant 1 of School A responded as:

> *"…most of them lack basic knowledge and simple maths understanding and they happen to miss very simple maths concepts, they have knowledge gaps that makes it very difficult to grasp the new concepts which are now being taught."* (P1, SA)

This was further compounded by compulsory admission policy in which secondary schools are allocated learners in Grade 8 from primary schools. Participant 4 of School B added that compulsory admission resulted in the schools having to admit learners who lack the necessary mathematical skills and knowledge and responded as:

> *"We take [learners] across all the primary schools, we don't choose one primary school but even there we usually take those who are better performers but even if you have done so, there is usually a group that will come at the end because you only do it as far as you cannot just say I only take the best performers, that would appear as if you have discriminated…but because we are a Maths-Science academy we also need to ensure that we get better performers."* (P4, SB)

Departmental heads for mathematics concurred with principals. When asked to describe the learners' foundational knowledge when they enter the FET phase in Grade 10, the responses indicated that learners enter Grade 10 with huge gaps in

mathematical knowledge, competency and basic skills which makes their understanding of mathematics at FET phase more difficult.

Participant 2 believed that learners reach the FET phase in Grade 10 with a three-year knowledge and skills gap from lower grades. The response was:

> *"Then actually they do not have the skills like how do you use a calculator or geometrical instruments, so those skills they are supposed to develop in primary school or even in Grade 8 and 9, the GET phase, those are the skills they are not developing the skills… I heard that one [CCNA] also did research in which they are giving a Grade 11 learners a Grade 8 question paper or a Grade 9 paper and they are unable to solve that one meaning that that gap is almost 2 years, 3 years gap and in some cases, it can even go to a three-year gap, so it's a huge gap."* (P2, SA)

Parents also bemoaned the same issue of lack of foundational knowledge for their children. Asked about the challenges that their children face in their study of mathematics, Participant 5 responded:

> *"The majority have challenge that I can speak about is, my child was saying as far as he is concerned, he is lacking the basic, the basic foundation of maths that is why at some point we had to look for tutors. If he was having the early help so that he could know maths he wouldn't be having the struggles that he is facing now. In fact, he lacks early foundation, foundation, foundation, the basics of maths. So that is the problem that I can say."* (P5, SB)

One of the elements of the Bronfenbrenner (1979, 2006) bioecological model of human development is contexts and under contexts there is a sub-element of mesosystem which entails transition between environments. What is happening in one environment may have a spill over effect in the other environment. Based on the data presented above, it can be established that learners lack foundational knowledge and skills in mathematics from lower grades. Secondly, learners enter secondary schools in Grade 8 from primary schools without the appropriate knowledge and skills in mathematics. It also appears that learners are not being developed properly in mathematics in primary schools to prepare them to be competent in mathematics. This gap in knowledge and skills widens as learners progress through secondary school as

they move from one grade to the next and from the GET to the FET phase. By the time they enter Grade 12, the gap is large and there is then a challenge to address the gap and prepared them to write the Grade 12 examination. It can thus be deduced that learners' lack of foundational knowledge and skills in mathematics from lower grades might be one of the factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor academic performance of Grade 12 learners in mathematics.

The admission of learners to public schools is regulated by the South African School Act (1996:6) which states that the school governing body (SGB) is responsible for setting a school's admission policy and that such a policy should not unfairly discriminate any learner in any way. Furthermore, the National Education Policy Act (1996:9) stipulated that the Head of Provincial Education Department is responsible for all admissions of learners in the province and should ensure that all eligible learners are admitted to schools around the province. As a results, schools cannot decline admission of any learner neither do they have the choice of choosing learners with certain qualities since learners are allocated to them by the Head of Provincial Education Department through local circuit offices.

The above findings were also established by various other scholars such as Bayat *et al.* (2014:47) who stated that poor quality of education at primary school level is viewed by principals, educators, school management teams (SMTs) and school governing bodies (SGBs) as the main contributor to poor performance of Grade 12 learners in mathematics. Other studies which established lack of foundational knowledge and mathematics skills from lower grades as one of the factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor academic performance of Grade 12 learners in mathematics, include Sinyosi (2015:49); Maddock and Maroun (2018:200) and Rankhumise (2018:99).

4.4.3.2 Sub-theme 2: Grade promotion policy and practice

Promotion of learners from one grade to the next as well as from one phase to the other plays a significant role in the ability of learners to cope with the requirements of senior grades. This aspect emerged as one of the sub-themes during data analysis in this study. If learners who have not acquired the necessary competences are

promoted to higher grades, they struggle in higher grades because they lack foundational concepts.

Interviews with principals revealed that the grade promotion policy results in unprepared learners being promoted to higher grades until they are promoted to Grade 12, but in many cases, learners have not acquired and developed the required mathematics concepts in lower grades.

Participant 4 of School highlighted the fact of compulsory promotion according to policy as:

> *"We apply the Department's directive as to what should be done, we never deviate because ultimately they have a final say to approve what we have done."* (P4, SB*)*

Probed if such directives have negative effects on the performance of learners in Grade 12, the participant replied:

> *"It does…[emphasis] …it does have a very negative one… You know if we are not an MSTA (Maths, Sciences, Technology & Arts) school like in Grade 10 our learners choose between Accounting and Geography. I am telling you they run away from Accounting and to Geography but we force them… So, if there was a choice in Maths they would also have done the same. It's just that they no choice except to do Maths. At our school there is no choice, they must do Maths and we also have got no choice we have to deal with everyone."* (P4, SB)

Participant 6 bemoaned the fact that the grade promotion policy admitted learners who had not achieved the required level and were being promoted. These learners lacked foundation for the requirements of senior grades. The response of Participant 6 was worded as:

> *"Hey, promotion of learners in our school, we need to promote learners but we need to promote learners who are competitive enough to be able to go to Grade 12… A good foundation is needed so that learners would be able to pass and achieve bachelors and achieve distinctions in maths in Grade 12."* (P6; SC)

The exosystem under the contexts in the Bronfenbrenner (1979, 2006) bioecological model of human development explained the impact of decisions that are made in an

environment in which a developing person is not an active participant. Grade promotion policy is made at national level but it directly impacts learners when they progress from one grade or one phase to the next. The data presented in the paragraphs above seem to suggest that grade promotion was ultimately done by the district education department with schools taking directives from the district. As a result, learners without the necessary competences are being promoted to higher grades. Such learners then struggle in higher grades since they were promoted without a good foundation from junior grades. As a result, their performance in the Grade 12 mathematics examination becomes compromised. Grade promotion policy and practice might be among factors affecting the collective management process of mathematics teaching and learning and hence contributing to the poor academic performance of Grade 12 learners in mathematics.

The grade promotion policy for schools in South Africa is regulated by the National Education Policy Act (1996:11) which stipulates that every learner should progress with his/her age cohort in such a way that no learner shall be three years, or more, older than the age norm of the class. Specifically, the Act prohibits multiple repetition in one grade and the standard norm is that a learner can only repeat once in each phase. The findings above were in line with findings by Louw *et al.* (2011:87) and Bayat *et al.* (2014:53), who established that promotion of learners due to poor grade promotion policy and practice was one of the factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor academic performance of learners as they progress to higher grades.

4.4.3.3 Sub-theme 3: Using English as language of learning and teaching

Language barriers can also hinder the process of teaching and learning. When a language used for learning and teaching differs from the learners' mother or home language(s), it is possible that some learners might fail to properly understand or express themselves in that language of learning and teaching. Secondly, it becomes even more difficult for learners to understand subject content if they are failing to understand or express themselves in the language used in teaching and learning. During data analysis of this study, the use of English as the LoLT in the schools studied emerged as a sub-theme.

Asked for their views on the impact of using English as a language of learning and teaching of mathematics, principals concurred that using English as the LoLT presented some teaching and learning barriers.

Participant 1 believed that using English as a medium of instruction in mathematics is as per policy and the language policy of the school; however, some learners might not have developed the required proficiency or level of CALP necessary to understand the mathematics question and be able to answer successfully. This was embedded in the following response:

> *"All the schools in South Africa are using English as a medium of instruction, so it is good that learners use English though some of them might not understand everything in English and it makes it very difficult to answer some of the questions, but because all the questions are asked in English, children are coerced to know English language. The maths concepts are expressed in English especially at a secondary level."* (P1, SA)

Participant 4 believed that the challenges of using English as the LoLT is compounded because often teachers' proficiency is not adequate for the teaching at the higher levels. The participant further expressed the view that schools need to devise programmes of intervention to help mitigate barriers presented by the use of English as a language of instruction. Participant 4's response was worded as:

> *"I think it [English] would not have an impact if for instance teachers were teaching in English accordingly. You find that even English teachers are teaching English in their home languages….so it's about how the teacher does it, if the teacher is disciplined and say this is the language of teaching and stick to it, then it would be a language of learning, so it won't be a language of learning until the teachers make that it is the language in which they want to teach. Now the issue of learners not understanding, we need to have a programme to address that, our schools because they lack resources, we are unable to do those things."* (P4, SB)

Participant 2 believes that teachers even at primary school level do not keep using English as a language of instruction in the classrooms as teachers prefer to use their home languages to teach, not matter which subject they teach. This means that

learners consistently through the grades do not develop the relevant competency level or CALP and find themselves unable to express themselves adequately in English. The participant's response was recorded as:

> *"Maybe from primary school teachers mostly are explaining in their mother tongue, when they come to a class, [so now when learners] come to a teacher who knows English, who is only using English as a medium of instruction, there is a huge gap of understanding… I am not saying our learners [are not understanding English], they do understand what we are explaining but the problem is expressing themselves, yeah, there is, yeah, that gap, they don't know how to express themselves."* (P2, SA)

Non-participant observations in three classrooms at the schools in the study revealed that English was being used as a language of learning and teaching. The researcher could not however, ascertain the degree to which learners understood the language during only one lesson observation.

The exosystem under the contexts in the Bronfenbrenner (1979, 2006) bioecological model of human development highlighted that learners are affected by decisions and policies that are made in environments where they do not participate directly. The overarching language policy is done at national, provincial and SGB levels. From the data presented in the paragraphs above, it could be ascertained that English was the elected at the LoLT for mathematics at the schools in the case study. The data also revealed that, although mathematics is not an English intensive subject, the use of it (English) as a language of instruction in mathematics still presented teaching and learning barriers, particularly as learners have not developed appropriate competency levels (CALP – see Cummins, 1979) which results in them failing to properly understand English thereby making it even more difficult to grasp the mathematics concepts. Furthermore, even in situations where learners can understand, they may even fail to express themselves adequately and therefore may struggle to answer questions. These challenges were further compounded by the fact that teachers do not use English consistently in the teaching of mathematics in classrooms. This phenomenon starts at lower grades in primary schools where teachers prefer to use their local languages to teach in classrooms. As a result, learners do not develop

English language proficiency and the language gap increases as learners progress upwards between grades.

The language of instruction (LoLT) is provided for and is regulated by a number of policy documents. The South African Schools Act (1996:8) stipulates that the school governing body is responsible for setting the language policy of a school in line with the Constitution and all applicable Acts of Parliament and that all languages should enjoy equitable treatment when it comes to possible selection as a language of learning and teaching. The National Education Policy Act (1996:4) stipulates that every learner should be accorded the right to receive education and training in a language of his/her choice provided that it is practicable. The Language in Education Policy (1997:2) further clarified the guidelines that schools and their governing bodies (SGBs) should follow when drafting their language policies. The LiEP Policy stipulates that language(s) of learning and teaching should be an official language in South Africa. Secondly, the school should offer the language of learning and teaching as a subject at the school so that learners can learn the language as a subject. In addition to the language of learning and teaching, learners at FET Phase are required to take an additional language subject at first level or above (Language in Education Policy, 1997:2).

Cummins (1979:198) discovered that cognitive/academic language proficiency, which is the degree to which learners understand and are able to express themselves in a given language, is directly related to intelligence quotient (IQ) and other aspects of academic achievement. The aspect of the use of English as language of learning and teaching was studied by various other scholars who reached the same finding and these include Mji and Makgato (2006:263); Makgato (2007:99-100); Bayat *et al.* (2014:49); Heeralal and Dhurumraj (2016:310) and Makofane and Maile (2019:44).

4.4.4 Theme 4: Technological Factors

Guided by the revised Bronfenbrenner's bioecological model of human development, as outlined in the theoretical framework, this study added another theme of factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics. This theme relates to the impact of technological advances on learner performance in mathematics. This theme arose from the first component of human

development which encompasses proximal processes. Proximal processes are complex and reciprocal interactions between the developing person and objects, other persons and symbols that happen regularly over extended periods of time and they happen in the immediate environment in which the developing person normally resides. The second decade of the new millennium has brought about a wide range of technological advances characterised by smart devices and applications that have become more accessible to people of all age groups and income levels. The most pervasive of these are smartphones and their applications. Almost every learner in secondary school has access to smart phones and other devices. The interaction between learners and these smart devices could possibly impact on their performance in mathematics and as a result, this was included in this study.

4.4.4.1 Sub-theme 1: Inappropriate use of modern-day technologies

In today's world, learners are exposed to various forms of modern-day technologies due to the proliferation of affordable computers, other smart devices and internet connectivity. This exposure presents both advantages and disadvantages. Generally, responses from different participants indicated support for the integration of modern-day technologies in classroom teaching and learning.

Principals were in support of the use of modern-day technologies in supporting teaching and learning; however, they contended that there was a need to encourage positive use of such technologies. Participant 1 highlighted the need to develop collaboration between technology and human minds and responded as:

> *"There are advantages and disadvantages in using technology but nowadays we have to accept that technology is part of us. The technology devices and all gadgets are all accurate and handy but also it promotes dependency syndrome which does not ignites the N-functioning of the natural mind. Therefore, I believe there should be a collaboration between the use of technology and the human mind."* (P1, SA)

Parents, elaborated more on the likely impact of modern-day technologies on learners' performance in mathematics. There was general agreement that it depends on what learners are using the technology for. The response of Participant 5 was worded as:

"They use the technology that is not that effective. They rather use internet for social media than using it to study and search for educative material. I think they need to be motivated and be shown how to use the internet effectively." (P5, SB)

Participant 8 weighed in and said:

"Uhm uhm, WhatsApp and Facebook are not helpful to them but if they open educational pages these can be very helpful to their learning but Facebook and WhatsApp are those things that stress us a lot as parents… These are the things that waste their time a lot. I also check what is in my child's laptop to know what he is using the laptop for." (P8, SC)

Data presented in paragraphs above suggested that there is general support for the adoption of modern-day technologies in teaching and learning in schools. However, the use of modern-day technologies comes with both positive and negative effects on learners' performance in mathematics and other subjects. For those who use technology positively and productively, the impact on performance in mathematics is likely to be positive and for those who use it negatively, the impact on learners' performance is also likely to be the reverse. The data also suggested that using modern-day technologies ineffectively for things like social media can be detrimental to learners' performance in mathematics. Resultantly it can be inferred that inappropriate use of modern-day technologies, such as social media, can waste learners' time and therefore can distract them from studying mathematics. This inappropriate use of modern-day technologies can thus be a factor contributing to poor academic performance of Grade 12 learners in mathematics.

The findings above corresponded to Raja and Nagasubramani (2018:34) who discovered that the use of technology in education can have a positive impact such as improved interactions between teachers and learners and between learners themselves through improved sharing capabilities. Use of technology breaks geographical barriers and can enable learners and/or teachers to communicate even if they are not geographically close to one another. However, there are some negative impacts which include declining writing skills of learners due to over-reliance on technology, lack of focus due interruptions by other media on technological devices such as messages and social media, increased instances of cheating and reduced students' imagination and thinking ability (Raja & Nagasubramani, 2018:34).

4.5 DOCUMENT ANALYSIS

The third data collection and analysis method employed in this study was document analysis, specifically policy document analysis which entailed qualitative content analysis of educational policy documents. According to Cardno (2018:625), educational policy has a hierarchy of levels starting from the highest level which encompasses legislation which governs education provision nationally. This layer consists of Acts of Parliament. The second layer consists of national policies and regulations normally developed by relevant departments and ministries. These policies and regulations are intended to guide lower levels in developing their organisational policies, rules, regulations and codes which form the third layer of educational policy.

This study concentrated on the highest and middle layers which are Acts of Parliament and national policies and regulations. The policy documents used in this study were downloaded from the National Department of Basic Education (DBE) website and are shown on Table 4.3 below. Cardno (2018:628) cited a conceptual framework for educational policy document analysis as provide by Taylor *et al.* (1997). The framework specified that policy analysis should be predicated on three main aspects of context, text and consequences. Policy context refers to the forces and values that drive the formulation of a policy, policy text refers to the actual content of the policy document itself whereas policy consequences refer to the way in which policy is implemented and therefore its results. This study focused on policy context and policy text of the conceptual framework. The document names were used as main sub-headings in this section.

Table 4.3: Educational policy documents used for the study

DOCUMENT NAME	DOCUMENT TYPE
Constitution of the Republic of South Africa, Act No. 108 of 1996	Act of Parliament
South African Schools Act, Act No. 84 of 1996	Act of Parliament
National Education Policy Act, Act No. 27 of 1996	Act of Parliament
Employment of Educators Act, Act No. 76 of 1998	Act of Parliament
Terms and conditions of employment of educators	National Policy
Language in Education Policy of 1997	National Policy

DOCUMENT NAME	DOCUMENT TYPE
National Curriculum Statement (NCS) Curriculum and Assessment Policy Statement – Mathematics FET Phase Grades 10-12	National Policy

4.5.1 Constitution of the Republic of South Africa, Act No. 108 of 1996

The Constitution of the Republic of South Africa (1996) was founded on the ideals of healing social divisions of the past Apartheid era and to establish a society based on democratic values, social justice and respect of fundamental human rights for all citizens and visitors. The Constitution provides for education and has accorded every citizen a right to basic and further education which the state should strive to make available and accessible. In addition, the Constitution accords every citizen the right to receive education in a language of his/her choice at public educational institutions when it is reasonably practicable to do so. Thirdly, the Constitution also specifies the official languages to be recognised in the Republic of South Africa and these are: Afrikaans, English, isiNdebele, isiXhosa, isiZulu, Sepedi, Sesotho, Setswana, siSwati, Tshivenda, Xitsonga and Sign Language. These languages should enjoy equality in terms of esteem and must be treated equitably including for use in education. The constitutional provisions on languages and their possible use in education have a significant bearing on the selection and adoption of language of learning and teaching (LoLT) in public educational institutions such as schools in South Africa.

4.5.2 South African Schools Act, Act No. 84 of 1996

The South African Schools Act (1996) was passed to redress past imbalances in education which were premised on racial inequality, and segregation. In addition, the Act was promulgated in order to improve the quality of education for all which would produce learners with talents and capabilities who would promote democratic and social transformation, eradication of poverty and enhance economic wellbeing of societies throughput South Africa. The Act also set to promote and uphold the rights of learners, educators and parents. All the above would be accomplished by setting universal norms and standards for education of learners at schools in South Africa, organisation, governance and funding of schools throughout South Africa. The provisions in this Act have covered several factors that affect the collective management process of mathematics teaching and learning and hence impact on

learners' academic performance in general and mathematics in particular. The following paragraphs outline the various provisions and their link to factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor academic performance in mathematics.

The South African Schools Act (1996) provided for compulsory attendance to schools and has placed the responsibility on parents, guardians and caregivers to ensure that children under their care should attend school from the first school day of the year in which their children reach the age of seven years until the last school day of the year in which their children reach the age of fifteen year or reach ninth grade (Grade 9). The Member of Executive Council responsible for education in each province has the responsibility of ensuring that there are enough school places for all learners in his/her province so that every learner can attend school. These provisions should impact truancy, late-coming and absenteeism in South African schools since parents are expected to monitor and ensure regular attendance by their children.

The Act also provides for admission to public schools and states that all public schools must admit learners and provide for their educational needs without any form of discrimination. As such no public school, through its school governing body (SGB), is allowed to administer any admission test. The Act further states that no learner can be refused admission to a public school on grounds of failing to pay school fees or for not subscribing to the mission statement of the school. Overall, it is the responsibility of the school governing body (SGB) to set the school's admission policy which must be consistent with national laws and policies. These provisions mean that public schools have no influence on the quality of learners that they can admit in all subjects and discipline.

The South African Schools Act (1996) makes provision for language policy for public schools and specifies that the minister responsible for education, in consultation with the Council of Education Ministers, sets the norms and standards for language policy for public schools. The ultimate responsibility for setting language policy in public schools rests with each school's governing body (SGB), in consultation with parents. The Act further prohibits racial discrimination when setting language policy in that all official languages, including Sign Language, should be considered for possible inclusion as language of learning and teaching (LoLT).

Provisions were also made for the crafting of codes of conduct by public schools. The Act stated that it is the responsibility of the school governing body (SGB) to adopt a code of conduct for its school after consultations with parents, learners and educators. Such a code of conduct is aimed at creating a disciplined and conducive school environment for teaching and learning as well as maintaining and advancing the quality of teaching and learning. The guidelines to be followed in crafting a code of conduct for a public school are issued by the minister responsible for education in consultation with the Council of Education Ministers. Codes of Conduct regulate learners' behaviour towards one another and towards educators and other staff members thereby impact on the aspect of safety, health and security around the school environment.

The functions of governing bodies are outlined in the South African Schools Act (1996). These include administering and controlling of school property, infrastructure such as buildings, grounds and hostels, if any and recommending the appointment of educators and non-educator staff to the Head of Provincial Education Department. Additionally, school governing bodies can apply, in writing, to the Head of Provincial Education Department to be allocated other functions such as buying of textbooks, teaching and learning materials and equipment for the school, maintaining and improving the school infrastructure such as buildings, grounds and other facilities as well as paying for services rendered at the school. These functions of the school governing bodies have a bearing on factors that affect the collective management process of mathematics teaching and learning and hence influence learner performance in mathematics such as classroom infrastructure which encompass desks, chairs, lighting and ventilation, availability of teaching and learning materials at a school.

4.5.3 National Education Policy Act, Act No. 27 of 1996

The National Education Policy Act (1996) was promulgated to provide for national policy for education in various matters. The major motivation of the Act was to facilitate the democratic transition of the system of education into one that serves all the people of South Africa equitably, fairly and justly and also to uphold the rights of all educational stakeholders. Several provisions are made in this Act that relate to this study and these include choice of the language of learning and teaching (LoLT), teacher-learner

interactions, safety and security measures, compulsory admission as well as control and discipline of learners in educational institutions.

The National Education Policy Act (1996) was passed to uphold fundamental human rights as enshrined in The Constitution of the Republic of South Africa which include the right of every learner to receive education and training in the language of his/her own choice taking into consideration the practicability of such choices. This has an influence on the languages of learning and teaching (LoLT) in schools. The Act also provided for the interactions between learners and educators and specified that learners and educators should respect one another and that each learner or educator should respect the rights of other learners and other educators. The Act further specifies that the ultimate responsibility of learners' behaviour and attitudes rests with parents and that parents should support the education of their children and ensure that their children attend school regularly. Parents are also expected to attend meetings convened for them by the school governing bodies.

Provisions were also made for admission of learners in public schools. The Act stated that the Head of Provincial Education Department is responsible for all learner admissions to public schools in his/her province. As such, the Head of Provincial Education Department should work with school governing bodies and coordinate all admissions to public schools in order to ensure that all eligible learners are accommodated within public schools in the province. Each school governing body has the responsibility of setting the admission policy of that school and must submit a copy of such policy to the Head of Provincial Education Department, and such policy should not unfairly discriminate any learner on any grounds. The admission policy to a public school cannot require the school to administer any admission test except in circumstances of technical fields, sports, dance or music where such tests can be appropriate. Finally, no learner can be denied access to school services on grounds of his/her parents' failure to pay fees or refusing to subscribe to the mission of the school. These provisions affect the quality and calibre of learners that a school can admit especially secondary schools, when they admit learners in Grade 8 from primary schools.

The Act further provides for promotion of learners from one grade to the next and from one phase to the next. The Act states that a learner has progress with his/her age

cohort; that is to say, a learner cannot be admitted into a grade for which age norm for that grade is three years lower than the learner's age, except if such an admission is authorised by the Head of Provincial Education Department. The Act stipulates that the norm of repetition is one year per each school phase and that multiple repetition in one grade is impermissible. These provisions impact on the knowledge capabilities of learners as they progress from junior grades to senior grades.

The seven roles of an educator are also outlined in the National Education Policy Act (1996). The first role entails an educator as a mediator of learning in which role an educator is expected to create a conducive environment for learning with specific considerations for learner diversity, recognition of barriers to learning. The educator should also demonstrate sound knowledge of the content of the subject. These provisions border on teachers' quality, content knowledge and experience.

The National Education Policy Act (1996) provides for qualifications of teachers/educators in the schooling system in South Africa. The Act specifies that for educators to be registered by the South African Council of Educators (SACE) as professionally qualified, that educators should be in possession of a qualification with 360 South African Qualifications Authority (SAQA) credits or Relative Education Qualification Value (REQV) Level 13. The Act further stipulates that educators should thus possess a Bachelor of Education degree or a first Bachelors' degree plus a Postgraduate Certificate in Education for such an educator to be recognised to be on REQV Level 13, which would enable the educator to be professionally registered by the South African Council of Educators (SACE). This provision also impacts on teachers' quality, content knowledge and experience.

The health, safety and security measures in and around school facilities are also outlined in the Act. These measures are stated in specific response to drug abuse and other malfeasance in and around the school premises. The Act prohibits and condemns the possession, exchange and use of drugs by learners within and around school premises. Furthermore, the Act prohibits random searches of learners but authorises searches where there is reasonable suspicion that a certain learner(s) is/are in possession of prohibited substance(s). Such searches should be structured and should be conducted in a decent and orderly manner respecting the rights of the learner(s) concerned. The searches can only be administered by a person of the same

gender to the suspected learner(s) in the presence on a person of the learner(s) choice and a third person who would witness the searches.

4.5.4 Employment of Educators Act, Act No. 76 of 1998

The Employment of Educators Act (1998) was passed in order to regulate the hiring, employment, retention, rewarding and punishing of educators by the State. The Act also provides for the terms and conditions of service for educators as well as the disciplining, retiring and discharging of educators from service. The Act specifies that the employer of all educators in a province is the Head of Provincial Education Department and a public school is the employer of all educators employed in that particular school.

For all public schools, the responsibility for shortlisting and selection of educators rests with the school governing body (SGB) and it is the governing body which recommends the appointment, promotion and transfers of educators within their school to the Head of Provincial Education Department. An educator can only be appointed if he/she is registered or qualifies to be registered by the South African Council of Educators (SACE) and also meets the minimum requirements for appointment or promotion or transfer stipulated by the minister responsible for education. Appointment of educators is done with due regard to equity, equality and other virtues that include the ability of the potential educator and the need to redress past imbalances.

The Employment of Educators Act (1998) provides for the establishment of the South African Council of Educators (SACE). The major functions of the South African Council of Educators include determining the minimum requirements and procedures for temporary or permanent registration of educators in South Africa and to maintain a register of persons registered as educators in South Africa. Furthermore, SACE can also institute disciplinary measures against educators and can sanction or reprimand any of its members, impose a fine or deregister any member found guilty of offenses. SACE also establishes a code of ethics for all educators in South Africa which guides the conduct of all educators and forms the basis of sanction in the event of contravention by educators.

Finally, the Employment of Educators Act (1998) provides working hours for educators and specifies that educators should avail themselves for work for such a time that the

minister responsible for education may determine that educators may not perform remunerative work outside their official duties. In addition, educators may not claim remuneration for work performed voluntarily or for work they are requested to do by a competent authority. These provisions have a bearing on late coming and absenteeism by teachers.

4.5.5 Language in Education Policy, 1997

The Language in Education Policy of 1997 was written with reference to Section 3(4)(m) of the National Education Policy Act (1996) and Section 6(1)-(4) of the South African Schools Act (1996). The LiEP policy is constantly developed in relation to the national language plan across all sectors of the society. The major specifications in this policy include the provision that the language(s) of learning and teaching (LoLT) should be one of the official languages recognised by the Constitution of the Republic of South Africa. These languages are Afrikaans, English, isiNdebele, isiXhosa, isiZulu, Sepedi, Sesotho, Setswana, siSwati, Tshivenda, Xitsonga and Sign Language.

Secondly, the Policy stipulates that all learners in Grades 1 to 3 should be offered one approved official language as a subject. In Grades 3 to Grade 12, all learners should be offered their language of learning and teaching as subject and an additional approved official language as subject. The policy further states that all language subjects should be treated equitably in terms of time and resources. As for promotion based on languages, for Grades 10 to 12, two language subjects must be passed of which one should at first language level and the second one at second level or above. All these subjects must be official languages in South Africa.

4.5.6 Terms and Conditions of Employment of Educators, 1995

The regulations regarding the terms and conditions of employment of educators (1995) were passed with reference to the Educators Employment Act (1994) and was subsequently amended several times. One of the regulations stipulates that all persons to be appointed or promoted as educators should have the minimum experience and minimum qualifications, as stipulated by the minister responsible for education. This condition can be waivered, that is, persons who do not meet the experience and qualifications stipulated by the minister, can be appointed or promoted as educators in temporary capacity, provided that such appointment or promotion is

necessary and in the best interests of education. This has a bearing on the teachers' quality, content knowledge and experience in mathematics.

Other important regulations in the terms and conditions of employment of educators relate to official duty and attendance of educators. The regulations state that educators are deemed to be on official duty if they are at school during periods specified on the school timetable, which reflect curriculum or times approved by the employer at the school or during periods for which other activities related to the school are taking place. Additionally, the regulations state that educators should give full attention to their official duties and should not be absent during hours of official duty without consent of the head of the school or relevant office. Furthermore, the school should maintain attendance registers where educators record their times of arrival and departure. These regulations impact on late coming and absenteeism by educators.

4.5.7 National Curriculum Statement (NCS): Curriculum Assessment and Policy Statement (CAPS) Mathematics – Further Education and Training Phase Grades 10 – 12

The National Curriculum Statement (NCS): Curriculum Assessment and Policy Statement (CAPS) Mathematics – Further Education and Training Phase Grades 10 – 12 to be shortened as CAPS Mathematics FET Phase was implemented from 2012 in order to provide for curriculum and assessment policy for mathematics from Grades 10 to 12. The statement also provided to national policy on promotion requirements from Grades 10 to 12 with reference to mathematics and also on national protocol for assessment for the same grades.

The CAPS Mathematics FET Phase stipulates that the time allocation for mathematics for Grades 10 to 12 should be 4.5 hours (four and half hours) per week. Further to the time allocation, the statement outlines the ten main content areas of mathematics in the Further Education and Training (FET) Phase. These content areas are: Functions; Number patterns, Sequences and series; Finance, growth and decay; Algebra; Differential calculus; Probability; Euclidean geometry and measurement; Analytical geometry; Trigonometry and Statistics. The time allocation with reference to the topics and main content areas influence syllabus length and completion.

4.6 SUMMARY

In this chapter the data collected were presented, analysed and interpreted. Data were collected using in-depth interviews, non-participant observations and educational policy document analysis. Except for one interview participant who was a departmental head for mathematics at one of the schools who declined to participate, all other interviews, together with non-participant observations and educational policy document analysis went as planned. Data from in-depth interviews was audiotape recorded and transcribed into written Microsoft Word documents for all the participants. Data from observations were recorded on the protocols as field notes. Educational policy documents were downloaded from the Department of Basic Education website. All data from the three methods were analysed using qualitative content analysis by developing appropriate codes, categories and themes from the raw data collected. The categories and themes emerged from the literature review and theoretical framework. The findings of this study were classified under three broad themes which are parental and social level factors, school level factors as well as system and policy level factors.

This study established that under parental and social level factors, parents' lack knowledge of mathematics; learners' natural ability in mathematics and their negative attitudes towards mathematics; inadequate parental control and monitoring over their children's school attendance and school work and unconducive neighbourhoods and social environment all affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics. Under school level factors, truancy, late-coming and absenteeism; lack of innovative teaching strategies by mathematics teachers; inadequate and poor quality of learning and teaching materials; scope and length of syllabus as well as high teacher-to-learner ratios all affect collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics. Under system and policy level factors, lack of foundational knowledge and mathematics skills of learners from lower grades; the practice of promoting undeserving learners from one grade/phase to the next as well as the use of English as language of learning and teaching (LoLT) all affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics.

Finally, the inappropriate use of modern-day technology, such as social media, also impact negatively on Grade 12 learners in mathematics. All other factors do not have an impact on the collective management process of mathematics teaching and learning and hence academic performance of Grade 12 learners in mathematics. The next chapter presents the summary, conclusions and recommendations of this study.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

In the previous chapter, the findings of the analysis of data were presented and interpreted. In this chapter, conclusions and recommendations derived from the data analysis are presented. The objective of this study was to answer the research questions that were put forward in Chapter 1. The main research question for this study was stated as: *What factors affect the collective management process of mathematics teaching and learning in the Highveld Ridge East Circuit in the Gert Sibande Region of Mpumalanga, South Africa?*

In order to answer the main research question, the following sub-questions have been formulated:

1. What parental and social level factors affect the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?
2. Which school level factors influence the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?
3. How do system and policy level factors affect the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?
4. How does technology impact on the collective management process of mathematics teaching and learning and performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?

In the following sections, the major findings on parental and social level factors, school level factors as well as system and policy level factors are presented. These are followed by recommendations to school principals, parents as well as policy makers.

5.2 MAJOR FINDINGS

The findings that emerged from this study were presented in detail in Chapter 4. These findings were classified under four major themes and within each theme, emerging sub-themes were also presented. The major themes that emerged in this study were

parental and social level factors, school level factors, system and policy level factors and technological factors. The following subsections present major findings under each of these major themes.

5.2.1 Parental and Social Level Factors

The first objective of this study was to explore parental and social level factors that impact collective management process of mathematics teaching and learning and performance of Grade 12 learners in secondary schools in Highveld Ridge East Circuit. Parental and social level factors are those attributes and conditions that emanate from families and societies where learners come from. The following paragraphs outline major findings in regard to the first objective.

This study established that parents are involved in the education of their children by checking the children's school work, school reports as well as by engaging with mathematics and class teachers. This study also highlighted that parents attend, or sent proxies to attend, meetings that are called for them by the schools (see Subsection 4.4.1.1). As a result, the study found that parental involvement might not be one of parental and social level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor performance of Grade 12 learners in mathematics. The revised Bronfenbrenner's bioecological model of human development in the mesosystem under the component of contexts outlined that the interactions between two or more settings in which the developing person is an active participant; for example, the interconnections between home and school, play an important role in the successful development and hence performance of such a person (learner) (see Subsection 2.61.3). Empirical literature in previous studies have established that lack of parental involvement in the education of their children contributed to poor performance of learners in mathematics (Mji & Makgato, 2006:261; Makgato, 2007:98). Further to that Gniewosz and Watt (2017:1380) highlighted that in addition to parental involvement in the education of their children, the parents and teachers' views and beliefs on the children's abilities in mathematics plays a critical role in stimulating the learners' interest in the subject and therefore in their intrinsic mathematical development.

As set out in Subsection 4.4.1.2, the study secondly revealed that parents are able and could afford to provide extra assistance to their children above what they get from

their schools. This assistance ranged from organising study groups, securing other material support such as study guides and laptops, arranging private tutorials for mathematics and also by ensuring that their children attend school organised extra tuition. However, the greatest challenge was that some parents lack knowledge of mathematics and as such, they cannot assist their children directly with their challenges in mathematics. Therefore, this study concluded that parents' lack of mathematics knowledge to directly assist their learners where they struggle, might be one of the factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor performance of Grade 12 learners in mathematics. The theory of learning highlighted the important influence of family, societal and cultural beliefs and influences on the performance of a learner in attaining school goals (Taylor & Baker, 2006:387) (see Subsection 2.6.2). Previous studies also found that income levels and the social status of parents and caregivers affect the performance of learners in mathematics. Udida *et al*. (2012:135), Sinyosi (2015:54) and Mlachila and Moeletsi (2019:24) found that learners from high income families and families headed by parents and caregivers of high social status tend to perform better than learners from low-income families and families headed by parents and caregivers of low social status. These differences in performance were attributed to differences in the families' ability to provide financial, educational and cultural resources to their children such as providing extra private tuition, the parents' general attitudes and beliefs towards education. Sinyosi (2015:51-52) went further to conclude that literacy levels of parents and caregivers also affect the performance learners in mathematics, since semi-illiterate and illiterate parents and caregivers are unable to provide direct assistance to their children in areas where they struggle in mathematics.

This study further established that learners are generally motivated to pursue their schoolwork by studying alone at home, the challenge might be they might be studying other subjects other than mathematics or they might be studying mathematics but still fail to understand the concepts. However, there appears to be a negative attitude towards mathematics as some learners still view mathematics as a difficult subject. As a result, they lack interest in the subject and therefore cannot study on their own as they need constant assistance and supervision (see Subsection 4.4.1.3). Accordingly, this study concluded that learners' negative attitude of, and lack of interest in, mathematics as well as their view that mathematics is a difficult subject might be

among parental and social level factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor Grade 12 learner performance in mathematics.

The revised Bronfenbrenner bioecological model of human development outlined 'the person' as the second component that influences the development and performance of an individual or learner. The characteristics of the developing person are important in his/her development and performance (see Subsection 2.6.1.2). The negative attitudes of learners towards, and their lack of interest in, mathematics have also been discovered to contribute to their performance in mathematics. Sinyosi (2015:54) discovered that learners' general lack of interest in mathematics as well as their belief that mathematics is a difficult subject, affect their performance in the subject. Rankhumise (2019:99) and Naidoo and Kapofu (2020:1) also established that learners' negative attitudes towards mathematics impact negatively on their performance in mathematics since they will lack interest in the subject and therefore, they do not practise it on their own.

Fourthly, as presented in Subsection 4.4.1.4, the study further established that there is general lack of adequate parental control over their children in the communities. Parents are seemingly not monitoring their children's attendance and behaviour at school. A number of factors were outlined as causes of such as lack of adequate parental control over their children, parents' work and other commitments, parents' lack of education and therefore their indifference when it comes to monitoring their children's attitudes towards education. Resultantly, this study concluded that lack of adequate parental control over their children's behaviour might be among parental and social level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor performance of Grade 12 learners in mathematics.

The revised Bronfenbrenner bioecological model of human development outlined the importance of the microsystem, under the contexts, in fostering development and performance of a person (learner) (see Subsection 2.6.1.3). The National Education Policy Act (1996:12;20) placed the responsibility of ensuring good behaviour of school children on their parents and this included the duty to ensure regular school attendance of their children. Empirically, Heeralal and Dhurumraj (2016:314) found

that lack of adequate parental control over their children impacts negatively on learners' performance in physical sciences and therefore, also in mathematics. This study further established that most working parents do not have enough time to monitor their children's behaviour and attitudes towards schoolwork.

Furthermore, this study found that the communities in which learners reside are not safe and conducive for proper education. The communities are rife with many negative social vices among school going children such as substance abuse, crime, teenage pregnancies and general state of lawlessness and despair among the youth. These negative social vices might resultantly affect concentration of Grade 12 learners in their school work in general and in mathematics in particular. Again, these negative social vices also affect the learners' attendances at school and in some cases, might even lead to school dropouts (see Subsection 4.4.1.5). This study therefore concluded that unconducive and unsafe communities that are rife with crime, substance abuse, teenage pregnancies as well as general lawlessness among young people might be among parental and social level factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor Grade 12 learners' performance in mathematics.

The theory of learning explained the role that the societal environment as well as societal influences play in influencing performance of learners (see Subsection 2.6.2). Heeralal and Dhurumraj (2016:310) discovered that the general state of neighbourhoods and social backgrounds of learners affect their performance in physical sciences. As such, learners from negative neighbourhoods and social environments tend to perform badly in comparison to learners who live in better and safer neighbourhoods and social environments.

5.2.2 School Level Factors

The second objective of this study was to establish school level factors that influence the collective management process of mathematics teaching and learning and performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit. School level factors are conditions and attributes that are influenced by the school environment and for which each school has significant influence. As such, these conditions and attributes vary from one school to the next. The major findings on school level factors are outlined in the next paragraphs.

Firstly, this study found that generally there are adequate safety and security measures within and around school premises save for minor learner conflict which are considered manageable. There seems to be collaboration between schools and other security stakeholders in the communities (see Subsection 4.4.2.1). As a result, it could be concluded that safety and security around the school environment is not among school level factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor performance of Grade 12 learners in mathematics. The theory of learning identified the academic environment which encompasses the general environment within which learning takes place as one of the factors that affect the collective management process of mathematics teaching and learning and hence the performance of learners (see Subsection 2.6.2). The South African School Act (1996:12) tasked the School Governing Bodies (SGBs) to draft a Code of Conduct for learners which regulate behaviour and interactions of learners and educators within the school environment. Empirically, Louw *et al.* (2011:70) found out that low safety and security within and around the school environment impacted negatively on the performance of learners generally and particularly in mathematics.

The second finding of this study under school level factors was on truancy, late-coming and absenteeism. In Subsection 4.4.2.2, this study discovered that late-coming by learners and teachers is still prevalent in schools studied in this case study. Truancy and absenteeism, although now controlled to some extent, is also prevalent in the schools studied. This late-coming, truancy and absenteeism create gaps in mathematics content for the lessons that the learners miss due to late-coming or being absent altogether. Accordingly, this study concluded that truancy, late-coming and absenteeism are among school level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor performance of Grade 12 learners in mathematics. Secondly, the South African Schools Act (1996:6) provided for compulsory attendance for all learners of school going age and that the National Education Policy Act (1996:12) placed the responsibility of ensuring school attendance of learners on their parents. Previous studies have found that truancy, late-coming and absenteeism are among causes of poor performance of learners in mathematics. Such late-coming and absenteeism tend

to be more evident during Mondays, Fridays and month-ends (Masitsa, 2004:229; Mlachila and Moeletsi, 2019:32).

In Subsection 4.4.2.3, this study presented findings on teachers' quality, content knowledge. The study found that mathematics teachers are qualified and recently, appointments of new teachers are made from the Funza Lushaka Bursary scheme. This means that all new teachers now possess degrees in education. Further to the above, teachers also are experienced and have sufficient content knowledge. However, the study discovered that some of the teachers lack confidence, and do not implement innovative methods and techniques in their teaching of mathematics. As such, this study concluded that teachers' lack of confidence, lack of innovative methods of teaching and classroom techniques might be among school level factors that affect the collective management process of mathematics teaching and learning and hence impact negatively on the performance of Grade 12 learners in mathematics. The theory of learning emphasised the interactions between instructors (teachers) and learners focusing mainly on the methods and materials used as well as the influence of peers. These all interact to influence the performance of learners and their drive in attaining desired goals (see Subsection 2.6.2). The National Education Policy Act (1996:47) articulated that one of the major roles of an educator is to mediate learning in such a way that it identifies and eliminates barriers to learning. As such, an educator should possess sufficient content knowledge of the subject matter so as to instil interest and confidence in the learners. Makofane and Maile (2019:43-45) established that lack of content knowledge by mathematics teachers is one of the factors affecting collective management process of mathematics teaching and learning and hence contributing to learners' poor performance in mathematics. Additionally, George and Adu (2018:135) discovered that poor teaching strategies adopted by mathematics teachers or the ways in which the teachers present the subject matter was one of the factors that affect the collective management process of mathematics teaching and learning and hence impact negatively on the performance of Grade 12 learners in mathematics.

Fourthly, this study established that the relationships between mathematics teachers and learners were sound as teachers and their learners interacted well in classrooms. However, the study also found that learners with little content knowledge of mathematics seemingly lack confidence and therefore do not participate in classrooms

by asking and responding to questions in the classrooms (see Subsection 4.4.2.4). As such, learners' lack of confidence and therefore minimal participation in the classroom might be concluded to be among school level factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor performance of Grade 12 learners in mathematics. On the relationship between mathematics teachers and learners, the Porter and Lawler (1968) expectancy theory suggests that the instructor/learner relationship is one of the key factors that influence the performance of learners in a subject. As such, for the learners to perform better, there should be a 'fit' between the qualities of the instructor, the methods of teaching employed, the subject itself and the quality of the learner (Taylor & Baker, 2006:385-386) (See Subsection 2.6.2). At policy level, the National Education Policy Act (1996:19) stipulated that learners should interact with each other and with educators and non-educator staff with mutual respect and should respect of each other's rights and diverse views.

This study is able to report on the state of school infrastructure such as desks, chairs, ventilation and lighting in Grade 12 mathematics classes. The study discovered that there is adequate ventilation and lighting except when electricity outages during adverse weather conditions compromise lighting. Furthermore, there are adequate desks and chairs in a good state in Grade 12 mathematics classrooms. Although there were challenges during the period of the COVID-19 pandemic, generally there are adequate desks and chairs in Grade 12 classrooms during normal times (see Subsection 4.4.2.5). Accordingly, this study concluded that the state of classroom infrastructure in terms of desks, chairs, ventilation and lighting is good and therefore it is not among school level factors that affect the collective management process of mathematics teaching and learning and hence might contribute to poor performance of Grade 12 learners in mathematics. The South African Schools Act (1996:16) placed the responsibility of administering, controlling, maintenance and improvement of school infrastructure such as buildings and grounds on the School Governing Bodies. Previous literature indicated that the poor state of classroom infrastructure such as desks and chairs, the poor state of classroom environment such as poor ventilation and lighting as well as overcrowded classes, all have a negative impact on learners' performance in mathematics (Louw *et al.,* 2011:68).

In Subsection 4.4.2.6, findings on the state of the availability of mathematics teaching and learning materials were presented. This study found that there is a shortage of teaching and learning materials such as textbooks, teacher and learner guides. In addition, some of the available teaching and learning materials are of poor quality and are not very useful in the teaching and learning of mathematics. In the end, it can be concluded that shortage of teaching and learning materials as well as poor quality of some such materials might be among the school level factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor performance of Grade 12 learners in mathematics. The theory of learning indicated materials as well as presentation of material as some of the factors that influence the learners' effort and therefore their ultimate performance (Taylor & Baker, 2006:387) (see Subsection 2.6.2). On the availability and quality of teaching and learning materials, previous studies revealed that shortage of teaching and learning materials such as textbooks, teaching and learning guides as well as poor quality of such materials contributed to poor learner performance in mathematics (Mlachila & Moeletsi, 2019:34; Heeralal & Dhurumraj, 2016:312; Rankhumise, 2018:99).

This study can also report on teachers' workloads, syllabus length and completion as presented in Subsection 4.4.2.7. This study established that teachers' workloads in terms of number of lessons were normal and in accordance with policy, although there seems to be overcrowded classes above the normal teacher-learner ratio of 1:35. Additionally, the length of Grade 12 mathematics syllabus seems to be acceptable although learners are failing to cope with it and as a result, some topics might need to be rationalised. Accordingly, it can be concluded that overcrowded classes as well as the inclusion of some complex topics in the Grade 12 mathematics syllabus might be among school level factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor performance of Grade 12 learners in mathematics. The Grade 12 mathematics curriculum highlighted the ten major content areas that should be covered before learners write their matric examinations (DBE, 2011:9). In addition, the Department (DoE, 2009:66) stipulated that the normal teacher-learner ratio for secondary schools is 1:35 and 1:40 for primary schools. Previous studies found that overcrowded classes with teacher-learner ratios above the ratio stipulated were one of the causes of poor performance of Grade 12 learners in mathematics since teachers are overwhelmed and cannot sufficiently

monitor the performance of all learners in the classrooms (Louw et al., 2011:69; Bayat *et al.,* 2014:49).

5.2.3 System and Policy Level Factors

The third objective of this study was to unearth system and policy level factors that affect the collective management process of mathematics teaching and learning and performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit. System and policy level factors are conditions and confinements that are placed on all schools in South Africa or in Mpumalanga through laws, policies, rules and regulations. The findings under system and policy level factors are presented in the following paragraphs.

Firstly, this study discovered that learners lack foundational knowledge and mathematics skills from lower grades and as a result, they reach secondary schools in Grade 8 without the needed skills for them to perform well at that level. Furthermore, this knowledge and skills gap widens as learners proceed from one grade to the next and from one phase to the next. This situation is compounded by the fact that admission to public schools is mandatory and schools do not have a choice when admitting learners in Grade 8 from primary schools. Additionally, learners cannot be denied subjects that they, and their parents, have chosen and as a result many unworthy learners get admitted into mathematics classes (see Subsection 4.4.3.1). Consequently, this study concluded that compulsory admission and lack of foundational knowledge and mathematical skills from lower grades and the widening gap as learners proceed in secondary education, are some of the factors under system and policy level that affect collective management process of mathematics teaching and learning and hence contribute to poor performance of Grade 12 learners in mathematics.

Bronfenbrenner and Morris (2006:796) explained the second characteristic of a developing person as bioecological resources characteristics which include the person's ability, experience, knowledge and skills which are required for effective functioning of the proximal processes at any developmental stage of a human being (See Subsection 2.6.1.2). At any developmental stage, these characteristics influence the performance of the developing person. At policy level, the admission of learners into public schools is provided for by the South African Schools Act (1996:6), which

stipulates that the school governing body (SGB) is responsible for setting the admission policy of a public school and such policy should avoid discrimination of any kind in the admission of learners. The National Education Policy Act (1996:9) went further to clarify it as the duty of the Head of Provincial Education Department to ensure that all eligible learners in the school going age bracket are admitted to public schools. Due to these policies, public schools do not have the option of choosing students with certain qualities to be admitted and to do mathematics. Bayat *et al.* (2014:47) established that school principals, educators, school management teams (SMTs) and school governing bodies (SBGs) believed that poor quality of primary school education was one of the major reasons learners perform poorly in mathematics at higher grade as they lack proper foundation at lower grades. The finding that lack of proper foundational knowledge and mathematical skills from lower grades is one of the factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor learner performance in mathematics in Grade 12 was established by other scholars such as Sinyosi (2015:49); Maddock and Maroun (2018:200) and Rankhumise (2018:99).

Secondly, this study presented findings on the grade promotion policy and practice in Subsection 4.4.3.2. The study found that promotion of learners is done by the district education department through local education circuit offices. This promotion practice results in learners being promoted from one grade to the next without them having acquired the required competencies to perform well in the higher grades. Accordingly, this study concluded that the inappropriate grade promotion policy and practice that results in the promotion of undeserving learners might be one of the system and policy level factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor performance of Grade 12 learners in mathematics. At policy level, the National Education Policy Act (1996:11) stipulates that every learner should progress with his/her age cohort in such a way that no learner shall be three years or more older than the age norm of the class. Specifically, the Act prohibits multiple repetition in one grade and the standard norm is that a learner can only repeat once in each phase. However, empirical studies have established that weak grade promotion policy and practice that results in undeserving learners being promoted up the grades until Grade 12 is one of the factors affecting the collective management process of mathematics teaching and learning and hence contributing

to poor performance of grade 12 learners in mathematics (Louw *et al.,* 2011:87; Bayat *et al.,* 2014:53).

Thirdly, the impact of the language of learning and teaching (LoLT) on the performance of Grade 12 learners in mathematics was analysed and presented in Subsection 4.4.3.3. This study revealed that although mathematics is not an English intensive subject, its use as a language of learning and teaching (LoLT) still presents learning barriers. These barriers include learners failing to comprehend English and therefore failing to understand the mathematics concepts. Additionally, even if learners understand English to some extent, the challenge is on expressing themselves when answering questions or when presenting mathematical ideas. As such, this study concluded that the use of English as a language of learning presents some learning barriers in mathematics and as such, it might be among system and policy level factors that affect the collective management process of mathematics teaching and learning and hence might contribute to the poor performance of Grade 12 learners in mathematics.

Under the academic environment in the theory of learning, it is stated that the way in which teaching and learning materials are presented plays a significant role in the effort and motivation of learners and hence ultimately goal attainment (Taylor & Baker, 2006:387) (see Subsection 2.6.2). As a result, the language of presentation also has an impact on goal attainment. Regarding the language of learning and teaching (LoLT), the South African Schools Act (1996:8) stipulates the school governing body (SGB) is responsible for setting a school's language of learning and teaching which should be among recognised official languages in South Africa. Furthermore, the National Education Policy Act (1996:4) stipulates that each learner should be afforded the opportunity to choose a language in which he/she receives tuition provided that it is reasonably practicable. Studies have revealed that the use of English as a language of learning and teaching impacts negatively on the performance of Grade 12 learners in mathematics whose home language is not English (Mji & Makgato, 2006:263; Makgato, 2007:99-100; Bayat *et al.,* 2014:49; Heeralal & Dhurumraj, 2016:310; Makofane & Maile, 2019:44).

5.2.4 Technological Factors

The recent advances in modern-day technologies mainly spearheaded by increasingly cheaper mobile technology and smart devices has made technology part of learners' everyday interactions. Such learners' interactions with technology have had positive and negative influences on learners' behaviour, attitudes and motivation.

This study established that although the use of modern-day technologies is encouraged, such use can bring both positive and negative impacts on learners' performance in general and in mathematics in particular. The study further found that inappropriate use of modern-day technologies such as dwelling much on social media can contribute to poor performance of Grade 12 learners in mathematics (see Subsection 4.4.4.1). Raja and Nagasubramani (2018:34) discovered that inappropriate use of modern-day technologies can negatively impact on learners' performance by reducing writing skills of learners due to overreliance on technology, lack of focus due interruptions by other media on technological devices such as messages and social media, increased instances of cheating and reduced students' imagination and thinking ability.

5.3 RESEARCH CONCLUSIONS

The main research question posed for this study in Chapter was: *What factors affect the collective management process of mathematics teaching and learning in the Highveld Ridge East Circuit in the Gert Sibande Region of Mpumalanga, South Africa?*

This question was further split into specific sub-questions which were posed as:

1. What parental and social level factors affect the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?
2. Which school level factors influence the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?
3. How do system and policy level factors affect the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?

4. To what extent does technology impact on the collective management process of mathematics teaching and learning and performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?

In Chapter 2, a theoretical framework was developed to guide this study. Two theories were identified which are the revised Bronfenbrenner's bioecological model of human development by Bronfenbrenner and Morris (2006) and the theory of learning by Taylor and Baker (2006). The revised Bronfenbrenner's bioecological model of human development comprises four principal components which are proximal processes, the person, the context and time (Bronfenbrenner & Morris, 2006:795). The theory of learning encompasses three major components which are the societal environment, the school environment and the family, community and cultural influences (Taylor & Baker, 2006:387). In the following sections, this study's research conclusions are presented in relation to the research questions posed in Chapter 1 as guided by the theoretical framework laid down in Chapter 2.

5.3.1 RQ1: What parental and social level factors affect the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?

Two of the components of the revised Bronfenbrenner's bioecological model are proximal processes and the developing person (learner). Proximal processes are progressive and complex processes of interaction between the developing person (learner) and objects, persons and symbols in the immediate environment in which the developing person (learner) exists and such interactions have to occur on a fairly regular basis over extended periods of time (Bronfenbrenner & Morris, 2006:795). The second component is the developing 'person' which entails three main characteristics of the person which are: disposition which encompass character, motivation, curiosity and responsiveness; bioecological resources of ability, experience, knowledge and skills and demand characteristics that can promote or discourage reactions from the social environment (Bronfenbrenner & Morris, 2006:796) (see Subsections 2.6.1.1 and 2.6.1.2). As such, the proximal processes and the person's interactions mostly happen at parental and social level at home and in the immediate societal environment. Two of the three components of the theory of learning are family, societal and cultural influences and the societal environment (Taylor & Baker, 2006:384-385) (see section

2.6.2). As with proximal processes and the person in the revised Bronfenbrenner's bioecological model of human development, the family, societal and cultural influences and the societal environment of the theory of learning also fall under parental and social level.

The answers to the research question posed above can be stated as that:

- Parental involvement in the education of their children does not negatively contribute to poor academic performance of Grade 12 learners in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.1.1).
- Parents' lack of mathematics knowledge to directly assist their learners where they struggle might be one of the factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor performance of Grade 12 learners in mathematics in secondary schools in Highveld Ridge East circuit (see Subsection 4.4.1.2).
- Learners' negative attitude of, and lack of interest in, mathematics as well as their view that mathematics is a difficult subject might be among parental and social level factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor Grade 12 learner performance in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.1.3).
- Lack of adequate parental control over their children's behaviour might be among parental and social level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor performance of Grade 12 learners in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.1.4).
- Unconducive and unsafe communities that are rife with crime, substance abuse, teenage pregnancies as well as general lawlessness among young people might be among parental and social level factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor Grade 12 learners' performance in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.1.5).

5.3.2 RQ2: Which school level factors influence the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?

The third component of the revised Bronfenbrenner's bioecological model of human development is the contexts which is split into three sub-components which are the microsystem, the mesosystem and the exosystem. The microsystem encompasses the members/persons or objects of the system or environment that participate actively and intensely in the life of the developing person on a fairly regular basis over extended periods of time. Members/persons included in the microsystem are, inter alia, parents, relatives, close friends, teachers, mentors, co-workers, spouses, or others who participate in the life of the developing person on a fairly regular basis over extended periods of time (Bronfenbrenner & Morris, 2006:796). The mesosystem encompasses a set of interactions between two or more settings in which the developing person is an active participant; for example, the interconnections between home and school or between home and the televisions and other smart devices. The mesosystem occurs when the developing person engages in activities in more than one setting such that there is a transition from one setting to the other, like a Grade 12 mathematics learner spending time at home as well as time at school (Bronfenbrenner, 1979:209) (see Subsection 2.6.1.3). In the theory of learning, another component is the academic environment which encompasses the learner-instructor (mathematics teachers) interaction including methods and materials as well as peer influences all contributing to the learner's attainment of his/her goal of passing mathematics (Taylor & Baker, 2006:387) (see Subsection 2.6.2). The microsystem and the mesosystem of the revised Bronfenbrenner's bioecological model of human development and the academic environment of the theory of learning all encapsulate school level factors and their interaction with parental and social level factors in the mesosystem.

Considering the above theoretical guidance, this study answered the research question posed above as:

- Safety and security around the school environment might not be among school level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of

Grade 12 learners in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.2.1).

- Truancy, late-coming and absenteeism might be among school level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.2.2).
- Mathematics teachers' lack of confidence, less innovative methods of teaching and classroom techniques might be among school level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.2.3).
- Mathematics learners' lack of confidence and therefore minimal participation in the classroom might be among school level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.2.4).
- The state of classroom infrastructure in terms of desks, chairs, ventilation and lighting is good and therefore might not be among school level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.2.5).
- Shortage of teaching and learning materials as well as poor quality of some such materials might be among the school level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.2.6).
- Overcrowded classes as well as the inclusion of some complex topics in the Grade 12 mathematics syllabus might be among school level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.2.7).

5.3.3 RQ3: How do system and policy level factors affect the collective management process of mathematics teaching and learning and therefore performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?

The third class of environment under the revised Bronfenbrenner's bioecological model of human development is the exosystem which encompasses settings that do not involve the developing person as an active participant but in which events that occur therein affect the developing person. Additionally, there should be a causal link between the developing person and the setting where the developing person is not an active participant (Bronfenbrenner, 1979:237) (see Subsection 2.6.1.3). This exosystem therefore encapsulates system and policy level factors that affect the collective management process of mathematics teaching and learning and hence influence learner performance in mathematics but where the learner is not an active participant.

Guided by the theoretical framework, this study answered the above research question as:

- Compulsory admission and lack of foundational knowledge and mathematical skills from lower grades and the widening gap as learners proceed in secondary education might be among system and policy level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.3.1).
- Inappropriate grade promotion policy and practice that result in promotion of undeserving learners might be among system and policy level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics in secondary schools in Highveld Ridge East circuit (see Subsection 4.4.3.2).
- The use of English as a language of learning presents some learning barriers in mathematics that might be among system and policy level factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor academic performance of Grade 12 learners in mathematics in secondary schools in Highveld Ridge East circuit (see Subsection 4.4.3.3).

5.3.4 RQ4: How does technology impact on the collective management process of mathematics teaching and learning and performance of Grade 12 learners in secondary schools in the Highveld Ridge East Circuit?

The revised Bronfenbrenner's bioecological model of human development under the proximal processes highlighted the importance of the interactions between the developing person (learner) with objects and symbols in the immediate environment (Bronfenbrenner & Morris, 2006:795) (see Subsection 2.6.1.1). Additionally, under contexts in the microsystem, the revised Bronfenbrenner's bioecological model of human development emphasised that not only human beings interact with the developing person (learner) but also objects in settings such as the family, child-care arrangements, schools, peer groups, and neighbourhoods (Bronfenbrenner & Morris, 2006:796) (see Subsection 2.6.1.3). In light of the importance of modern-day technologies and learners' growing dependence on such technologies, this study included the contribution of technology to Grade 12 learners' performance in mathematics as a standalone category of factors that can impact on the performance of grade 12 learners in secondary schools in Highveld Ridge East circuit.

In light of the theoretical guidance outlined above, this study can answer the research question outlined above as:

- Although the use of modern-day technologies is encouraged, such use can have both positive and negative impacts on learners' performance in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.4.1).
- Inappropriate use of modern-day technologies such as dwelling much on social media might be among technological factors that affect the collective management process of mathematics teaching and learning and hence contribute to poor performance of Grade 12 learners in mathematics in secondary schools in the Highveld Ridge East circuit (see Subsection 4.4.4.1).

5.4 RECOMMENDATIONS FROM THE STUDY

The previous section offered conclusions for this study derived from major findings which were presented in Section 5.2. The final stage of this research study was to provide recommendations that can be given to parents, school management teams (SMTs) and school governing bodies (SGBs) to enhance an effective collective

management process of mathematics teaching and learning. This section offers such recommendations from this study emerging from the major findings and conclusions. The recommendations are presented in the following subsections:

5.4.1 Parental and social level factors that can enhance the effective collective management process of mathematics teaching and learning in the Highveld Ridge East Circuit

The recommendations under this subsection pertain to findings and conclusions regarding parental and social level factors. These recommendations are chiefly directed towards parents, guardians, caregivers and communities since they are the ones who possess much leverage to influence the outcomes under parental and social level factors. The recommendations are set below as:

Parents, guardians and caregivers are recommended to:

- offer more active support for their children in mathematics by checking their children's mathematics exercise books and engaging mathematics teachers regularly to discuss the progress of their children.
- engage regular tutors for mathematics to assist their children in areas with which they are struggling or on areas recommended by mathematics teachers, if they cannot themselves offer such assistance because of lack of mathematics knowledge or time.
- engage their children regularly to offer them moral support and cheering them on their progress in mathematics in order to motivate them and to eliminate the belief that mathematics is a difficult subject. If possible, refer their children to mentors who have passed mathematics and are now respected people in the society.
- be there for their children and be their children's role models so that they can influence their behaviour, their attitudes towards school authority and also check regularly their children's attendance at school.
- engage neighbours and other community leaders such as politicians, law enforcement authorities so that they make influence good behaviour in the communities that reduces crime, substance abuse, child pregnancies and general lawlessness.

5.4.2 School level factors that can enhance the effective collective management process of mathematics teaching and learning in Highveld Ridge East Circuit

This subsection offers recommendations that pertain to findings and conclusions on school level factors. These recommendations are chiefly targeted at school authorities who are school governing bodies (SGBs), principals and school management teams (SMTs). The recommendations are set below as:

- The school governing bodies (SGBs), principals and school management teams (SMTs) are recommended to establish committees that engage educators, learners and parents so as to monitor and control late-coming, truancy and absenteeism either from school or from mathematics classes.
- The school management teams (SMTs) are recommended to arrange in-school regular workshops to guide mathematics teachers in implementing innovative teaching methods and classroom management techniques which would instil confidence and motivation in mathematics teachers.
- The SGBs, principals and SMTs, in conjunction with higher education offices, are recommended to verify teacher-learner ratios and find ways of eliminating overcrowded or huge classes that are way above the normal average stipulated by policy.
- The SGBs, principals and SMTs, in conjunction with higher education offices, are recommended to find innovative ways of reducing the shortage of teaching and learning materials such as integrating modern electronic storage devices like laptops and tablets and have the materials loaded in electronic format.
- The principals and SMTs are recommended to devise extra tuition for mathematics by either using in-house teachers or engaging external experts to fill in the gaps and to add more tuition time.

5.4.3 System and policy level factors that can enhance the effective collective management process of mathematics teaching and learning in the Highveld Ridge East Circuit

In this subsection, recommendations pertaining to findings and conclusions on system and policy level factors are presented. These recommendations are directed towards school authorities such as SGBs, principals and SMTs. The recommendations are set out as:

- The SGBs and principals, in conjunction with high offices, are recommended to develop channels of engagement with primary schools around with a view of filling mathematics knowledge and skills gaps emanating from primary schools.
- The principals and SMTs are recommended to develop enrichment programmes mainly for Grades 8 and 10 levels which would identify mathematics knowledge and skills gaps, as well as filling those gaps that emanate from previous lower grades or phases.
- The principals and SMTs are recommended to develop enrichment programmes for English speaking and comprehension for both mathematics teachers and learners so as to fill language gaps and reduce language barriers. Secondly, such programmes need to encourage all teachers to use English as a medium of instruction.

5.4.4 Technological factors that can enhance effective collective management process of mathematics teaching and learning in Highveld Ridge East Circuit

This subsection offers recommendation with regard to findings and conclusions on technological factors. These recommendations are mainly directed towards school authorities such as SGBs, principals, SMTs. The recommendations are set out below as:

- The SGBs, principals and SMTs, in conjunction with high education offices, are recommended to device programmes that offer electronic storage devices, like laptops and tablets, to aid in teaching and learning of mathematics.
- The principals, SMTs and educators are recommended to devise a programme of familiarising learners on how to positively use electronic storage devices and modern-day technology for the benefit of learning.

5.5 AVENUES FOR FURTHER RESEARCH

This study recommends that more focused studies need to be done in most highlighted factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor performance of learners in mathematics not only in the Highveld Ridge East Circuit but in the province and the country. These include truancy, general state of neighbourhoods where learners reside; late-coming and absenteeism; shortage of learning and teaching materials; foundational

knowledge and mathematical skills from lower grades; grade promotion policy and practice as well as the use of English as a language of learning and teaching. These factors were noted and attention given by all participants in this study and as a result, they might be thought to be the most significant factors that need more informed and urgent handling.

5.6 LIMITATIONS AND DELIMITATIONS

Although other eight interviews went as planned, an interview at one of the sampled schools was not conducted as the participant could not volunteer to participate in the interview. Accordingly, this study could not obtain the views and contributions of that participant as initially planned. The impact of such failure to obtain that participant's views and contributions on the validity of the research findings could not also be established.

5.7 CONCLUSION

This study was motivated by the desire to establish factors affecting the collective management process of mathematics teaching and learning and hence contributing to poor academic performance of Grade 12 learners in mathematics in the Highveld Ridge East Circuit situated of the Gert Sibande District, Mpumalanga, South Africa. The desire was activated by consistent poor performance of Grade 12 learners in their final mathematics matric examinations over the past years. The study was duly conducted and all the study's research objectives were achieved, and consequently this report was compiled to document the study.

The research journey has taught me several lessons and has developed me as a person who can now analyse social situations better driven by scientific methods of inquiry. I have also learnt other valuable human attributes such as patience, endurance and adaptiveness. My interaction with participants has also helped me to understand that all stakeholders are driven by a common desire to see learners doing better and that it is possible to improve the collective management of teaching and learning of mathematics and hence also improve learners' performance in mathematics. I hope that in the future more educators, be they in administration or academia, will take interest in conducting more focused research mathematics teaching and learning.

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APPENDICES

Appendix A: Proof of Registration

UNISA university of south africa

1233 M1RST

RAMALEBA M M MS
P O BOX 6589
SECUNDA
2302

STUDENT NUMBER : 3621-844-8

ENQUIRIES NAME : MALEFO SP
ENQUIRIES TEL : 0124415702

DATE : 2022-12-12

Dear Student

I wish to inform you that your registration has been accepted for the academic year indicated below. Kindly activate your Unisa mylife (https://myunisa.ac.za/portal) account for future communication purposes and access to research resources.

DEGREE : MED (EDUC MANAGEMENT) (98405)

TITLE : Factors affecting collective management process of mathematics teaching and learning: A case for Highveld Ridge East Circuit, Mpumalanga

SUPERVISOR : Dr SJ RAPETA (rapetsj@unisa.ac.za)

ACADEMIC YEAR : 2022

TYPE: DISSERTATION

SUBJECTS REGISTERED: DFEDU95 MEd - Education Management

A statement of account will be sent to you shortly.

You must re-register online and pay every academic year until such time that you can submit your dissertation/thesis for examination.

Students registering for the first time for a dissertation or thesis must complete a research proposal in their first year of study. Guidelines will be provided by your supervisor/contact person.

If you intend submitting your dissertation/thesis for examination you have to submit an Intention to submit form (available on the website www.unisa.ac.za) at least two months before the date of submission. If submission takes place after 15 November, but before the end of January of the following year, you do need not to re-register and pay registration fees for the next academic year. Should you submit after the end of January, you must formally reregister online and pay the full fees.

Please access the information with regard to your personal librarian on the following link:
https://bit.ly/3hxNqVr

Yours faithfully,

Prof M S Mothata
Registrar

UNIVERSITEIT VAN SUID-AFRIKA PRETORIA UNIVERSITY OF SOUTH AFRICA

University of South Africa
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Appendix B: Ethical Clearance

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2021/05/12

Ref: **2021/05/12/36218448/04/AM**
Name: Ms MM Ramaleba
Student No.: 36218448

Dear Ms MM Ramaleba

Decision: Ethics Approval from 2021/05/12 to 2024/05/12

Researcher(s): Name: Ms MM Ramaleba
E-mail address: 36218448@mylife.unisa.ac.za
Telephone: 082 951 0906

Supervisor(s): Name: Dr SJ Rapeta
E-mail address: rapetsj@unisa.ac.za
Telephone: 012 429 2139

Title of research:

FACTORS CONTRIBUTING TO POOR ACADEMIC PERFORMANCE OF GRADE 12 MATHEMATICS LEARNERS IN HIGHVELD RIDGE EAST CIRCUIT, MPUMALANGA.

Qualification: MEd Education Management

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2021/05/12 to 2024/05/12.

*The **low risk** application was reviewed by the Ethics Review Committee on 2021/05/12 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa Covid-19 position statement on research ethics attached.
2. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

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3. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
6. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
7. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
8. No field work activities may continue after the expiry date **2024/05/12**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2021/05/12/36218448/04/AM** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

Prof AT Motlhabane
CHAIRPERSON: CEDU RERC
motlhat@unisa.ac.za

Prof PM Sebate
EXECUTIVE DEAN
Sebatpm@unisa.ac.za

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Appendix C: Letter of Permission to Conduct a Study

education
DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

Highveld Ridge East Circuit
1 Horwood Street
P/Bag X 9059
Secunda
2302
Telephone number: 017 631 1746, 1752, 1769
Fax number: 017 631 1950

HIGHVELD RIDGE EAST

Litiko leTemfundvo Umnyango weFundo Departement van Onderwys Umnyango wezeMfu

Enquiries: PS MOLEPO
Tel : 017 631 1762

TO : KIRIYATSWANE S.S, KUSASALETHU S.S AND K.I TWALA S.S

FROM : CIRCUIT MANAGER - HIGHVELD RIDGE EAST
MR PS MOLEPO

DATE : 01 OCTOBER 2021

SUBJECT: PERMISSION TO CONDUCT A RESEARCH STUDY IN THE ABOVE SCHOOLS

1. The above matter has reference.
2. This letter serves to confirm that Ms. Ramaleba MM student number 36218448 she's given permission from Circuit Manager to do the research
3. I hope you will find the above in order.

Kind regards

MPUMALANGA PROVINCE
HIGHVELD RIDGE EAST CIRCUIT OFFICE
2021 -10- 01
PRIVATE BAG X9059 SECUNDA 2302
DEPARTMENT OF EDUCATION

PS MOLEPO
CIRCUIT MANAGER
HIGHVELD RIDGE EAST CIRCUIT

DATE

Appendix D: Request for Permission to Conduct Research Study in Schools of the Mpumalanga Provincial Education Department

STUDY TITLE: FACTORS AFFECTING COLLECTIVE MANAGEMENT PROCESS OF MATHEMATICS TEACHING AND LEARNING: A CASE FOR HIGHVELD RIDGE EAST CIRCUIT, MPUMALANGA

STUDENT NUMBER: 36218448
Contact number: 082 951 0906

Email address: 36218448@mylife.unisa.ac.za

17 Colombia Street, Evander 2280

29 March 2021

LH Moyane
Director MPEDU
Head of Education
Mpumalanga Provincial Department of Education
Government Boulevard
Riverside Park
Building 5
Private Bag X11341, Nelspruit, 2000

Dear Mr. LH Moyane

I, Muriel M Ramaleba, am studying towards a Masters of Education (MED) in Educational Management with the UNISA College of Education. I am carrying out a research study titled: "*Factors affecting collective management process of mathematics teaching and learning: A case for Highveld Ridge East Circuit, Mpumalanga"* under the supervision of Dr SJ Rapeta (contact number: 012 429 2139 and email address: rapetsj@unisa.ac.za) who is a lecturer in the Department of Educational Management and Leadership.

We are requesting for permission to conduct this study at three schools that are located in Highveld Ridge East circuit in Gert Sibande Region in Mpumalanga. The main objective of this study is to establish major factors that impact on collective management process of mathematics teaching and learning by examining factors that contribute to poor academic performance of grade 12 leaners in their final Mathematics matric examinations.

The intended research study is a multisite case study and the three schools selected are believed to be suitable to extract relevant information to address the research questions and objectives.

At each of the three schools in the case study, I will conduct in-depth interviews with the principal, departmental head responsible for Mathematics and one purposively selected parent of a grade 12 mathematics learner. There will be 9 participants to be interviewed in total. Each of these interviews will last for roughly one hour to one hour and thirty minutes and no disruptions will be caused in the school programmes.

Secondly, I will conduct one nonparticipant observation in a selected Mathematics class at each of the schools in the case study. The observations will be done during Mathematics lessons as ordinarily conducted at the particular schools. In those observations, I will be a non-participant observer and will not participate in any of the classroom activities during those observation lessons.

Thirdly document analysis will be conducted at each of the schools in consultation with the concerned principals. Some of the document that will be analysed include student and staff registers, administrative documents, SGB policy documents on language of learning and teaching (LOLT), policy on admission and learner promotion, policy on learner absenteeism and policy on teacher recruitment.

As part of ethical requirements for educational research at UNISA College of Education, informed consent will be obtained from all participants and all data gathered will be held in confidence and be used strictly for purposes of this research study only. The identities of all participants and the schools will be strictly kept anonymous and will not be mentioned on any part of the research writings.

There are no potential risks anticipated in this study to any participants. There will be no compensation or incentives for participants in the research. Feedback methods will entail giving the participants through electronic mails the summary of the research report and findings.

I therefore kindly request for permission to conduct this research study at the schools selected and described above.

Yours sincerely

Ramaleba, MM (082 951 0906)
36218448@mylife.unisa.ac.za

Appendix E: Request for Permission to Conduct Research Study in Schools of The Gert Sibande Region.

STUDY TITLE: FACTORS AFFECTING COLLECTIVE MANAGEMENT PROCESS OF MATHEMATICS TEACHING AND LEARNING: A CASE FOR HIGHVELD RIDGE EAST CIRCUIT, MPUMALANGA

STUDENT NUMBER: 36218448
Contact number: 082 951 0906

Email address: 36218448@mylife.unisa.ac.za

17 Colombia Street, Evander 2280

29 March 2021

PP Magagula
Director Gert Sibande Region
Gert Sibande District Office
2 De Jager Street
Ermelo, 2551

Dear Mr. PP Magagula

I, Muriel M Ramaleba, am studying towards a Masters of Education (MED) in Educational Management with the UNISA College of Education. I am carrying out a research study titled: "*Factors affecting collective management process of mathematics teaching and learning: A case for Highveld Ridge East Circuit, Mpumalanga"* under the supervision of Dr SJ Rapeta (contact number: 012 429 2139 and email address: rapetsj@unisa.ac.za) who is a lecturer in the Department of Educational Management and Leadership.

We are requesting for permission to conduct this study at three schools that are located in Highveld Ridge East circuit in Gert Sibande Region in Mpumalanga. The main objective of this study is to establish major factors that impact on collective management process of mathematics teaching and learning by examining factors that contribute to poor academic performance of grade 12 leaners in their final Mathematics matric examinations.

The intended research study is a multisite case study and the three schools selected are believed to be suitable to extract relevant information to address the research questions and objectives.

At each of the three schools in the case study, I will conduct in-depth interviews with the principal, departmental head responsible for Mathematics and one purposively selected parent of a grade 12 mathematics learner. There will be 9 participants to be

interviewed in total. Each of these interviews will last for roughly one hour to one hour and thirty minutes and no disruptions will be caused in the school programmes.

Secondly, I will conduct two observations in a selected Mathematics class at each of the schools in the case study. The observations will be done during Mathematics lessons as ordinarily conducted at the particular schools. In those observations, I will be a non-participant observer and will not participate in any of the classroom activities during those observation lessons.

Thirdly document analysis will be conducted at each of the schools in consultation with the concerned principals. Some of the document that will be analysed include student and staff registers, administrative documents, SGB policy documents on language of learning and teaching (LOLT), policy on admission and learner promotion, policy on learner absenteeism and policy on teacher recruitment.

As part of ethical requirements for educational research at UNISA College of Education, informed consent will be obtained from all participants and all data gathered will be held in confidence and be used strictly for purposes of this research study only. The identities of all participants and the schools will be strictly kept anonymous and will not be mentioned on any part of the research writings.

There are no potential risks anticipated in this study to any participants. There will be no compensation or incentives for participants in the research. Feedback methods will entail giving the participants through electronic mails the summary of the research report and findings.

I therefore kindly request for permission to conduct this research study at the schools selected and described above.

Yours sincerely

Ramaleba, MM (082 951 0906)
36218448@mylife.unisa.ac.za

Appendix F: Request to Conduct Research Study in Schools in the Highveld Ridge East Circuit

STUDY TITLE: FACTORS AFFECTING COLLECTIVE MANAGEMENT PROCESS OF MATHEMATICS TEACHING AND LEARNING: A CASE FOR HIGHVELD RIDGE EAST CIRCUIT, MPUMALANGA

STUDENT NUMBER: 36218448
Contact number: 082 951 0906

Email address: 36218448@mylife.unisa.ac.za

17 Colombia Street, Evander 2280

29 March 2021

SP Molepo
Circuit Manager: Highveld Ridge East Circuit
Mpumalanga Department of Education
No. 1 Horwood Street
Old Mutual Building
Secunda 2302
Tel: 017 631 1743/69
Cell: 082 863 5564
Email: psmolepo@gmail.com

Dear Mr SP Molepo

I, Muriel M Ramaleba, am studying towards a Masters of Education (MED) in Educational Management with the UNISA College of Education. I am carrying out a research study titled: "*Factors affecting collective management process of mathematics teaching and learning: A case for Highveld Ridge East Circuit, Mpumalanga"* under the supervision of Dr SJ Rapeta (contact number: 012 429 2139 and email address: rapetsj@unisa.ac.za) who is a lecturer in the Department of Educational Management and Leadership.

We are requesting for permission to conduct this study at three schools that are located in Highveld Ridge East circuit in Gert Sibande Region in Mpumalanga. The main objective of this study is to to establish major factors that impact on collective management process of mathematics teaching and learning by examining factors that contribute to poor academic performance of grade 12 leaners in their final Mathematics matric examinations.

The intended research study is a multisite case study and the three schools selected are believed to be suitable to extract relevant information to address the research questions and objectives.

At each of the three schools in the case study, I will conduct in-depth interviews with the principal, departmental head responsible for Mathematics and one purposively selected parent of a grade 12 mathematics learner. There will be 9 participants to be interviewed in total. Each of these interviews will last for roughly one hour to one hour and thirty minutes and no disruptions will be caused in the school programmes.

Secondly, I will conduct two observations in a selected Mathematics class at each of the schools in the case study. The observations will be done during Mathematics lessons as ordinarily conducted at the particular schools. In those observations, I will be a non-participant observer and will not participate in any of the classroom activities during those observation lessons.

Thirdly document analysis will be conducted at each of the schools in consultation with the concerned principals. Some of the document that will be analysed include student and staff registers, administrative documents, SGB policy documents on language of learning and teaching (LOLT), policy on admission and learner promotion, policy on learner absenteeism and policy on teacher recruitment.

As part of ethical requirements for educational research at UNISA College of Education, informed consent will be obtained from all participants and all data gathered will be held in confidence and be used strictly for purposes of this research study only. The identities of all participants and the schools will be strictly kept anonymous and will not be mentioned on any part of the research writings.

There are no potential risks anticipated in this study to any participants. There will be no compensation or incentives for participants in the research. Feedback methods will entail giving the participants through electronic mails the summary of the research report and findings.

I therefore kindly request for permission to conduct this research study at the schools selected and described above.

Yours sincerely

Ramaleba, MM (082 951 0906)
36218448@mylife.unisa.ac.za

Appendix G: Participant Information Sheet

07 APRIL 2021

STUDY TITLE: FACTORS AFFECTING COLLECTIVE MANAGEMENT PROCESS OF MATHEMATICS TEACHING AND LEARNING: A CASE FOR HIGHVELD RIDGE EAST CIRCUIT, MPUMALANGA

Dear participant

I, Muriel M Ramaleba, am studying towards a Masters of Education (MED) in Educational Management with the UNISA College of Education. I am carrying out a research study titled: "*Factors affecting collective management process of mathematics teaching and learning: A case for Highveld Ridge East Circuit, Mpumalanga"* under the supervision of Dr SJ Rapeta (contact number: 012 429 2139 and email address: rapetsj@unisa.ac.za) who is a lecturer in the Department of Educational Management and Leadership. We are kindly requesting for your consent to participate in this study.

Your participation in the study involves answering a structured in-depth interview open-ended questions focusing on factors that affect grade 12 learners' performance in Mathematics. The interview will last for approximately one hour to one hour and thirty minutes and will be audiotape recorded using an audiotape recorder for transcription and further analysis. There are no direct rewards for participating in the interview, however your participation may assist in coming up with recommendations that will benefit the community by helping to improve academic performance of learners in Mathematics which will enhance our children's future endeavours post matric. There are no costs associated with participating in this study except your valuable time for attending the interview at your convenient date and time. Furthermore there are no known risks associated with your participation in the research study.

Your responses to questions in the interview will strictly be treated confidential and no one except the researcher will have access to them. Furthermore, your name will not appear in any part of the written study as only summary results of the study will be reported which are not recorded at individual and school levels. The findings of the study may be presented at meetings, seminars, conferences and in journal papers but your name will not be mentioned anywhere in those presentations. A copy of the written verbatim of the interview as well as the study's findings will be sent to you by email or any other method of your choice.

It is not a requirement that you have to participate in the interview. Participation is voluntary, you can choose not to participate at all or you can stop participating at any point without any penalty. You may also choose not answer particular questions that are asked in the interview and you may ask for clarification from the interviewer during the interview session. You may withdraw from participating at any time, for any reason

which you don't need to disclose without any consequences from the researcher or from UNISA College of Education.

If this consent form contains language that is not clear, or if you have questions or concerns about anything in this form or about participating in the study itself, please feel free to contact the student researcher and/or the supervisor on the details provided below. If you consent to participate in this study, please sign and return a consent form hereby attached. For any further details, please contact

Ramaleba, MM
082 951 0906
36218448@mylife.unisa.ac.za

Appendix H: Participant Consent Form (Please sign and return slip)

I……., confirm that the person asking my consent to participate in this research has told me about the procedure, nature of potential benefits and anticipated inconvenience of participation.

I have read and understand the study explained in the information sheet.

I have had enough time to ask questions and I am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty.

I am aware that findings of this study will be processed into a research project, journal publications and conference proceedings.

I also understand that my participation will be kept confidential unless otherwise specified.

I accept to the recording of the audio tape of the semi-structured interview.

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

……	……	……..
Name and Surname of participants	Signature	Date

Appendix I: Interview Protocol for Principals

OPEN ENDED INTERVIEW QUESTIONS FOR RESEARCH PURPOSES ONLY

STUDY TITLE: FACTORS AFFECTING COLLECTIVE MANAGEMENT PROCESS OF MATHEMATICS TEACHING AND LEARNING: A CASE FOR HIGHVELD RIDGE EAST CIRCUIT, MPUMALANGA

Name of school: _____
Name of participant: _____

INTRODUCTION AND STATEMENT OF PURPOSE

Good day Participant. My name is Muriel Ramaleba, I am a teacher at Kusasalethu Secondary School where I am also a departmental head for Life Orientation. Currently I am also doing my final research component of the degree Master of Education (MEd) in Education Management with the University of South Africa (UNISA) College of Education. Firstly, I want to thank you for agreeing to grant me this interview. The purpose of this interview is to find out from you your views on factors that affect performance of grade 12 learners in Mathematics.

Data collected from this interview as well as your identity will be kept confidential in accordance with the UNISA Code of Ethics for Researchers. Please feel free to answer questions in the best possible way you believe to be correct. The data collected will be used to make recommendations that might have profound effect to improve performance of our children around the Highveld Ridge East Circuit.

This interview session will last for one hour to one hour and thirty minutes and will be audiotape recorded on this smartphone to allow me to have further analysis and transcription after the session.

INTERVIEW QUESTIONS
PARTICIPANT BIODATA

Post Level	Grade 12 Enrolment	Gender	Age	Qualifications	Experience

Question 1
How was performance of grade 12 learners in Mathematics for the past five years?

Question 2
What are the skills required to teach Mathematics at your school?

Question 3

3.1 When recruiting teachers for Mathematics, what are the major attributes that you look for in a candidate?
3.2 What are your experience on the quality of newly graduated Mathematics teachers from colleges and universities in terms of content knowledge and methods of instruction?

Question 4
Describe the state of ventilation, lighting, desks and chairs in grade 12 classrooms?

Question 5
What are your precautions in terms of the safety and security of learners, teachers and non-teaching staff in and around the school environs?

Question 6
What are your thoughts on the preparedness of learners in mathematics when they arrive in grade 8 from primary schools?

Question 7
What are your comments on promotion of learners in mathematics from grade 8 to 12 at your school?

Question 8
What are your views on the use of English as the official language of learning and teaching (LOLT) on learners' performance in Mathematics?

Question 9
What are your views on the state of availability of Mathematics learning and teaching materials such as textbooks, stationery, teachers and learners' guides at this school?

Question 10
What are your views on the effects of modern day technologies – like smart devices, internet and social media – on academic performance of learners in Mathematics?

END
I thank you so much for your precious time going through this interview and your honest responses. Once again, let me reassure you that the purpose of this interview is academic and your identity and responses will strictly be kept confidential in line with UNISA Code of Ethics for Researchers. The findings of this research might have long term effects in improving the performance of our children in Mathematics which is a very important subject in their future endeavours.

Appendix J: Interview Protocol for Departmental Head - Mathematics

OPEN ENDED INTERVIEW QUESTIONS FOR RESEARCH PURPOSES ONLY

STUDY TITLE: FACTORS AFFECTING COLLECTIVE MANAGEMENT PROCESS OF MATHEMATICS TEACHING AND LEARNING: A CASE FOR HIGHVELD RIDGE EAST CIRCUIT, MPUMALANGA

Name of school: _____
Name of Participant _____

INTRODUCTION AND STATEMENT OF PURPOSE

Good day Participant. My name is Muriel Ramaleba, I am a teacher at Kusasalethu Secondary School where I am also a departmental head for Life Orientation. Currently I am also doing my final research component of the degree Master of Education (MEd) in Education Management with the University of South Africa (UNISA) College of Education. Firstly, I want to thank you for agreeing to grant me this interview. The purpose of this interview is to find out from you your views on factors that affect performance of grade 12 learners in Mathematics.

Data collected from this interview as well as your identity will be kept confidential in accordance with the UNISA Code of Ethics for Researchers. Please feel free to answer questions in the best possible way you believe to be correct. The data collected will be used to make recommendations that might have profound effect to improve performance of our children around the Highveld Ridge East Circuit.

This interview session will last for one hour to one hour and thirty minutes and will be audiotape recorded on this smartphone to allow me to have further analysis and transcription after the session.

INTERVIEW QUESTIONS
PARTICIPANT BIODATA

Post level	Gender	Age	Grade 12 enrolment	Number of grade 12 classes	Qualifications	Experience

Question 1
How was performance of grade 12 learners in Mathematics for the past five years?

Question 2
2.1 How experienced and qualified are mathematics teachers in your departments?

2.2 What are your experiences on the quality of mathematics teachers in terms of content knowledge and methods of instruction?

Question 3
How can you comment on the interactions between teachers of mathematics and their grade 12 learners in classrooms?

Question 4
Describe the state of ventilation, lighting, desks and chairs in grade 12 classrooms?

Question 5
What are the views of mathematics teachers on their workloads in your department?

Question 6
What are some of the major challenges that teachers of Mathematics raise in your departmental meetings regarding the teaching and learning of Mathematics?

Question 7
What are your comments on grade 12 mathematics curriculum in terms of length and appropriateness for the level of grade 12 learners?

Question 8
How can you describe the state of mathematics learning and teaching resources like textbooks, teachers' and learners' guides at this school?

Question 9
What are your comments on late coming and absenteeism of teachers and learners in Mathematics classes?

Question 10
10.1 How can you describe learners' foundational knowledge for mathematics when they enter the FET phase in Grade 10?
10.2 What can be the effects of using English as the Language of Learning and Teaching (LOLT) on the performance of learners in Mathematics?

END
I thank you so much for your precious time going through this interview and your honest responses. Once again, let me reassure you that the purpose of this interview is academic and your identity and responses will strictly be kept confidential in line with UNISA Code of Ethics for Researchers. The findings of this research might have long term effects in improving the performance of our children in Mathematics which is a very important subject in their future endeavours.

Appendix K: Interview Protocol for Parents

OPEN ENDED INTERVIEW QUESTIONS FOR RESEARCH PURPOSES ONLY

STUDY TITLE: FACTORS AFFECTING COLLECTIVE MANAGEMENT PROCESS OF MATHEMATICS TEACHING AND LEARNING: A CASE FOR HIGHVELD RIDGE EAST CIRCUIT, MPUMALANGA

Name of school: _____
Name of participant: _____

INTRODUCTION AND STATEMENT OF PURPOSE

Good day Participant. My name is Muriel Ramaleba, I am a teacher at Kusasalethu Secondary School where I am also a departmental head for Life Orientation. Currently I am also doing my final research component of the degree Master of Education (MEd) in Education Management with the University of South Africa (UNISA) College of Education. Firstly, I want to thank you for agreeing to grant me this interview. The purpose of this interview is to find out from you your views on factors that affect performance of grade 12 learners in Mathematics.

Data collected from this interview as well as your identity will be kept confidential in accordance with the UNISA Code of Ethics for Researchers. Please feel free to answer questions in the best possible way you believe to be correct. The data collected will be used to make recommendations that might have profound effect to improve performance of our children around the Highveld Ridge East Circuit.

This interview session will last for one hour to one hour and thirty minutes and will be audiotape recorded on this smartphone to allow me to have further analysis and transcription after the session.

QUESTIONS
PARTICIPANT BIODATA

Parent OR Guardian	Gender	Age	Employment status	Number of children and dependents	Highest qualifications	Experience

Question 1
How can you describe your child's pattern of absenteeism from school?

Question 2
What is the attitude of your child towards school work when he/she is at home?

Question 3
How can you describe the behaviour, character and motivation of your child?

Question 4
How can you describe the general performance of your child in his/her school work in general and in Mathematics in particular?

Question 5
5.1 What assistance do you provide to your child in his/her school work in mathematics?
5.2 how are you involved in the education of child in terms of checking homework, liaising with teachers and attending parents' consultative meetings?

Question 6
What are some of the major challenges that your child attribute to his/her study of Mathematics?

Question 7
What other support measures does your child receive at home or outside school in learning and studying mathematics?

Question 8
How can you describe the state of your neighbourhood in terms of safety and security, exposure of children to issues like alcohol, drugs and crime?

Question 9
What are your views on the general level of parental control over their school-going children around your neighbourhood and in the general society?

Question 10
What are your views on the effects of modern day technologies like internet, social media and smart devices on the performance of your child in his/her school work?

END
I thank you so much for your precious time going through this interview and your honest responses. Once again, let me reassure you that the purpose of this interview is academic and your identity and responses will strictly be kept confidential in line with UNISA Code of Ethics for Researchers. The findings of this research might have long term effects in improving the performance of our children in Mathematics which is a very important subject in their future endeavours.

Appendix L: Observation Protocol for Mathematics Lessons

STUDY TITLE: FACTORS AFFECTING COLLECTIVE MANAGEMENT PROCESS OF MATHEMATICS TEACHING AND LEARNING: A CASE FOR HIGHVELD RIDGE EAST CIRCUIT, MPUMALANGA

Name of school: _____
Classroom number/name: _____
Name of the Mathematics teacher: _____

INTRODUCTION AND STATEMENT OF PURPOSE

Good day learners. My name is Muriel Ramaleba, I am a teacher at Kusasalethu Secondary School where I am also a departmental head for Life Orientation. Currently I am also doing my final research component of the degree Master of Education (MEd) in Education Management with the University of South Africa (UNISA). Firstly, I want to thank you for being with me in this classroom. I am here to learn with you the subject of Mathematics as part of my research to establish factors that influence learners' performance in Mathematics.

Data collected from this lesson observation as well as your identities will be kept confidential in accordance with the UNISA Code of Ethics for Researchers. Please feel free to participate in this lesson the normal way you do on a day to day basis since I am not here to judge anyone or anything. The data collected will be used to make recommendations that might have profound effect to improve performance of our children around the Highveld Ridge East Circuit.

OBSERVATION GRID

OBSERVATION	DESCRIPTION
1. Who is in the group or scene?	What is the name of teacher of Mathematics? How many learners are present in the classroom? What is the gender composition of the learners in the classroom? How many learners are absent in that particular Mathematics lesson?
2. What is happening there? a. What behaviours are repetitive and irregular b. How do people in the group behave toward one another? c. What is the content of their conversation?	How is the teacher and learners conducting themselves in the lesson? Are there any actions by learners, either individually or in groups, which are irregular in nature? What is the level of the teacher's control of the class? Is the lesson interactive or one way from teacher to learners? What is the topic that the teacher is teaching in that particular lesson? Does the teacher exhibit content knowledge of the topic that he/she is teaching? Are the learners exhibiting interest and understanding of what is being taught? Which language(s) is/are dominant in the exchanges in the lesson? What are some non-verbal cues that can be deduced from the exchanges between the teacher and the learners?
3. Where is the group or scene located?	What is the physical state of the classroom in terms of size, state of desks and chairs, lighting, ventilation and general cleanliness? What resources are being used to conduct the lesson in terms of chalk boards, smart board and any other technologies? How are learning and teaching resources shared between learners and between learners and the teacher (E.g. how many learners are seated on one desk? How many learners are sharing a textbook, study guide or syllabus? What sights, sounds, smells, tastes and feelings are found in the classroom?
4. When does the group meet and interact?	What was the day and time of the Mathematics lesson?

OBSERVATION	DESCRIPTION
	How long is the Mathematics lesson at that school? How learners and the teacher utilise the lesson time (E.g. are learners and the teacher in class in time? Are there disruptions to the smooth flow of the lesson like learners going in and out during the lesson? How did the lesson come to an end?
5. How do the identified elements interrelate – from either the participants' or the researcher's perspective?	How is order and stability maintained in the classroom? Are the learners' showing confidence in their teachers? What can be generally described as the rules, norms and interactions in the Mathematics lesson as conducted that observation day? How the grade 12 class interfaces with other classes at the school does? (E.g. is there noises and distractions from other classes? How does the teacher and learners interface during transition of lesson at the beginning and end of the lesson?
6. Why does the group operate as it does?	Generally what conclusions can be drawn from the behaviour and interactions between learners and between the teacher and the learners? What symbols, values, traditions and worldviews can be deduced from the classroom interactions?

(Source: Format adopted from McMillan & Schumacher, 2014:379)

Appendix M: Proof of Editing

To whom it may concern

This letter serves to confirm that editing and proofreading was done for:

MMBANGISENI MURIEL RAMALEBA

Magister Educationis

Education Management

College of Education

University of South Africa

FACTORS AFFECTING COLLECTIVE MANAGEMENT PROCESS OF MATHEMATICS TEACHING AND LEARNING: A CASE FOR HIGHVELD RIDGE EAST CIRCUIT, MPUMALANGA

Cilla Dowse

31 December 2022 and re-edited after examination 22 May 2023

Cilla Dowse
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Appendix N: Turnitin Report

Factors affecting collective management process of mathematics teaching and learning: A case for Highveld Ridge East Circuit, Mpumalanga.

ORIGINALITY REPORT

24%	22%	9%	11%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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	repository.nwu.ac.za	

Appendix O: Declaration of own work

DECLARATION

Name: MMBANGISENI MURIEL RAMALEBA

Student number: 36218448

Degree: MASTER OF EDUCATION IN EDUCATION MANAGEMENT (98405)

Exact wording of the title of the dissertation as appearing on the copies submitted for examination:

FACTORS AFFECTING COLLECTIVE MANAGEMENT PROCESS OF MATHEMATICS TEACHING AND LEARNING: A CASE FOR HIGHVELD RIDGE EAST CIRCUIT, MPUMALANGA

I declare that the above dissertation is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

SIGNATURE

16-02-2023
DATE