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DISSERTATION

For the degree of

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With the provisional title:

CHALLENGES FACING TEACHERS IN TEACHING QUADRATIC FUNCTIONS IN GRADE 11 MATHEMATICS IN LUVUVHU CIRCUIT SCHOOLS

By

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DECLARATION

I, Netshifhefhe T.O. hereby declare that this dissertation for the degree Master of Education at the University of Zululand hereby submitted, has not been submitted previously for a degree at this or any other university, and that it is my own work in design and execution, and that all reference materials contained herein have been duly acknowledged.

…………………………… 08 November 2021

Netshifhefhe T.O Date

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- To all my study participants, may your endless love forever prevail.

DEDICATION

To my loving partner, Netshifhefhe Salphinah, with love. Your endurance motivated me more than you can imagine. This is for you and the children you always took care of during my absence conducting this research.

ABSTRACT

Quadratic functions are highly valued at Grade 11 Mathematics level. They help learners understand arithmetical, algebraic, and statistical concepts. However, learners seem to find quadratic functions difficult and have become a worry to those who teach Mathematics. This has led to parents and the government worrying about our learners' general performance in Mathematics. The Mathematics Senior Examiner's Reports regarding the National Senior Certificate (NCS) Examinations always indicate that learners perform poorly in this aspect of the Mathematics paper. Considerable challenges associated with teaching Quadratic Mathematics Functions at Grade 11 level in the Luvuvhu Circuit persist even today. This study aimed at establishing the challenges associated with teaching Quadratic Functions at Grade 11 Mathematics level in the Luvuvhu Circuit's Schools. It followed the quantitative research methodology and the quantitative research design to explore the challenges faced in the teaching of quadratic functions in Mathematics at the Luvuvhu Circuit's secondary schools. The IBM - SPSS version 25 was employed in analysing data. This study found that teachers face insurmountable challenges in teaching Mathematics' Quadratic Functions at Grade 11 level. It also found that learners' negative attitude towards Quadratic Functions is the biggest challenge. In addition, teachers' failure to vary their teaching methods, thereby failing to cater to other learners who are not comfortable learning through certain methods was are another notable challenge here. The study concludes that the process of teaching and learning in Mathematics in the Luvuvhu Circuit is dominated by challenges that tend to bog-down lesson deliveries. As a result, little attention is given to the learners' needs and expectations. It recommends that teachers should be inserviced in order to acquire challenge-solving skills in teaching quadratic functions.

Keywords: Challenges, Grade 11 Mathematics learners, Mathematics teachers, Teaching, Quadratic Functions.

LIST OF ABBREVIATIONS AND ACRONYMS

CAPS – Curriculum Assessment Policy Statement

FET – Further Education and Training

HOD – Head of Department

NCS – National Senior Certificate

NCTM – National Council of Teachers of Mathematics

OBE – Outcomes-Based Education

SA – South Africa

USA – United State of America

Mathematics - Mathematics

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CHAPTER 1: INTRODUCTION

1.1 STUDY BACKGROUND

People use Mathematics to solve problems related to their daily activities such as counting money, taking medicine doses, measuring distances and clothes size, reading time, and weighing objects, inter alia, (Peel, 2020). That is, on a daily basis, people find themselves quantifying what they have or hope to gain from their associates (Christie & Morris, 2019; Opper, 2019; Adler, 2015). Due to technology and the need for efficiency, Mathematics has evolved, and hence the complication associated with people's mathematical undertakings. Mathematics has led to the development and attainment of sophisticated scientific and technological equipment, resulting in mega structures coming into being (Sunbul & Gordesli, 2021). Industrially, supercomputers, robotics, space-ships, internet banking, inter alia, are now the norm (Opper, 2019; Samanian & Roohani, 2018; Akhtar, 2014).

Franke and Kazemi (2013) in Mamali (2015) assert that South Africa is poorly positioned when compared with other African countries in terms of Mathematics excellence. This is largely due to the challenges Mathematics teachers face when teaching quadratic functions. In South Africa, for example, teaching quadratic functions is regarded as very difficult and challenging, and hence the need to investigate the challenges that affect this concept's teaching in the Levuvhu North Circuirt (Sunbul & Gordesli, 2021). Teaching quadratic functions in schools has its own challenges. The challenges stem from unsubstantiated claims that Mathematics is a difficult subject, the learners' attitude, non-availability of teaching and learning media, and the teachers' poor teaching methods. Another challenge to teaching quadratic functions is the parents' non-involvement in the education of their children.

To understand some of the challenges faced by teachers when teaching quadratic functions, we need to accept that quadratic functions includes either a oneto-one correspondence or a many-to-one correspondence between two sets of numerical values (Peel, 2020). It is calculated thus, *y* □□*f* (*x*) indicates a function involving a single variable *x* that produces a mapping from *x*-values to *y*-values. For example, *f*

(x) □□$3x$ □1; $f(x)$ □□□x^2 □□□x □□□□□□□ Poor quadratic functions teaching has been attributed to the general poor results in Mathematics (Flockton & Cunningham, 2020; Holm & Kajander, 2012). Quadratic functions serve as the polynomial functions' starting level in Mathematics learning. Peel (2020) added that functions are the Mathematics field's bedrock. Also, this concept was chosen for its varied functions in careers that include, among others, business, engineering, and science. In business, we apply it when pre-determining profit and loss. The parabola's Ushape is included in science when making the satellite dishes' parabolic reflectors and the car's headlamps (Choi, 2019; Hudson & Hudson, 2010). Acquiring quadratic functions knowledge helps learners deal with different types of functions such as trigonometric, linear, exponential, and logarithmic (Flockton & Cunningham, 2020; Hine, 2015).

Learning quadratic functions is seen as problematic for learners at high school (Sorensen, 2021; Johnson, 2014). Teaching Mathematics' quadratic functions for more than two decades now has not provided me with different experiences in terms of the learners' performances in quadratic functions (McGarr, 2020). The issues with the learners' performances here cannot be divorced from the teachers' interactions with them (Klassen, Rushby, Tracy, Durksen & Bardach, 2021). In spite of the quadratic functions' significance in life, suffices it to understand that learners perform poorly here. Some of those who teach Mathematics in the Luvuvhu Circuit were observed complaining about the learners who perform badly during examinations, particularly on quadratic functions. But, teachers have remained resilient in the face of adversity (Opper, 2019; Kennedy, 2019). However, their efforts have not yielded positive results, given that learners continue to perform badly in Mathematics' quadratic functions, worse so in the national public examinations. A lot of them fail Mathematics examinations largely because they do noy understand quadratic functions and this has seen the national percentage pass rate drop every year (Opper, 2019; Kahan, Cooper & Bethea, 2013).

1.2 STATEMENT OF THE PROBLEM

The quadratic functions are highly valued at the Grade 11 Mathematics level despite the inherent challenges in its teaching and learning process. However, teaching this concept has challenges. Challenges faced by teachers when teaching quadratic functions affect the learners' performance in Mathematics. That is, with the challenges faced by teachers when teaching quadratic functions, learners are thus poorly taught and hence find it difficult to understand quadratic functions.

Consequently, challenges in teaching quadratic functions contribute to the learners' failure in Mathematics. This worries Mathematics teachers, parents, and government officials. The Senior Examiner's 2011 Mathematics Report for the National Senior Certificate (NCS) Examinations indicated that learners perform poorly in this aspect of the Mathematics paper (DBE, 2019). The Grade 11 Mathematics teachers often try to identify challenges faced by secondary school Mathematics teachers when teaching quadratic functions (Sunbul & Gordesli, 2021). Nevertheless, the Grade 11 Mathematics teachers have failed to solve problems concerning the challenges they face when teaching quadratic functions. This study's problem is that not much has been studied about the challenges faced by the Grade 11 Mathematics teachers when teaching quadratic functions in the Luvuvhu North Circuit.

1.3 AIM AND OBJECTIVES OF THE STUDY

This study explored the challenges associated with teaching Quadratic Functions in Grade 11 Mathematics level in the Luvuvhu Circuit's Schools.

The following objectives informed this study:

- To identify the challenges surrounding the teaching of quadratic functions at Grade 11 level in the Luvuvhu Circuit.
- To identify the challenges that affect learner performance in the quadratic functions aspect of Mathematics in the Luvuvhu Circuit.

- To identify challenges Mathematics teachers are faced with in teaching quadratic functions at Grade 11 level.

1.4 RESEARCH QUESTIONS

- What are the challenges surrounding the teaching of quadratic functions at Grade 11 level in the Luvuvhu Circuit?

- What are the challenges that affect learner performance in the quadratic functions aspect of Mathematics in the Luvuvhu Circuit?

- What are the challenges faced by teachers in teaching quadratic functions at Grade 11 level?

1.5 SIGNIFICANCE OF THE STUDY

I anticipate building new knowledge about the challenges that affect the teaching of quadratic functions at Grade 11 level. It is envisaged that Mathematics teachers, student teachers and other educationists involved with quadratic functions would benefit from this study as they would understand the challenges that affect quadratic functions teaching and learning. The quadratic functions are an inseparable aspect of our daily lives as they dominate our computer and robotic systems, and hence identifying challenges that affect their teaching and learning cannot be over emphasised. This study was undertaken to highlight the challenges faced by both teachers and learners in the teaching and learning of quadratic functions at the Grade 11 level. Its findings, therefore, would help formulate strategies to address such challenges. In addition, those teaching Mathematics at high school would be able to design programmes meant to overcome the said challenges in teaching and earning quadratic functions.

1.6 CHAPTER OUTLINE

The first chapter introduces this study in addition to providing its aim, objectives, and research questions. Also outlined in chapter one are this study's significance and the research problem.

Chapter 2 reviews literature related to the phenomenon under study. Literature is reviewed in the context of what other scholars wrote about issues investigated here. In addition, this study's theoretical framework is discussed.

In chapter 3, the methodology and research design adopted by this study are presented and discussed in detail. The focus here is to justify why these two were chosen instead of other methodologies and research designs. This chapter also discusses this study's population, the sampling techniques followed, the data collection methods and analysis used, and why these were opted for.

The following chapter 4 presents analyses and interprets data collected using the quantitative methodology. The data is presented the way it was obtained from the participants. It is presented in the form of graphs and tables as it is quantitative in nature. This made for easier interpretation and analysis.

Chapter 5 concludes this study by tying together what was found, discussed, analysed, and interpreted. Thereafter, recommendations are provided based on the study's findings and their implications.

1.7 SUMMARY

In this chapter, the introduction, and the study background, problem statement, methodology and the research design adopted were discussed. This included the aim, objectives and research questions. In addition, this chapter noted this study's delimitation, definitions of concepts, chapter outline, and summary. The next chapter provides a detailed literature review.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Chapter two reviews literature concerning the challenges that hinder the teaching of quadratic functions in secondary schools. This review also factored in issues bordering on what the teachers experience as they teach quadratic functions at Grade 11 level. However, before detailing this review, this study's theoretical foundation is discussed. The social constructivist theory that informed this study is explained. Literature is reviewed according to these sections; inter alia, the study's theoretical foundation, global and continental views on teaching Mathematics, teachers' levels of quadratic function teaching skills, challenges that affect the learners' performance in quadratic function, challenges facing teachers in teaching quadratic functions in Grade 11 Mathematics, and the challenges teachers face in teaching quadratic function. Literature review is guided by these study objectives:

- To identify the challenges surrounding the teaching of quadratic functions at Grade 11 level in the Luvuvhu Circuit.
- To identify the challenges that affect learner performance in the quadratic functions aspect of Mathematics in the Luvuvhu Circuit.
- To identify challenges Mathematics teachers are faced with in teaching quadratic functions at Grade 11 level.

2.2 THEORETICAL FRAMEWORK

The theoretical foundation helps situate this study in the context of the chosen theories. This study adopted and adapted the theories of learning in relation to the teaching and learning of Mathematics. Theories help teachers to conceptualise the teaching and learning processes and facilitate the interpersonal relationships between teachers and learners (Celik & Guzel, 2019). According to Illeris (2014); Ormrod (2015), learning is viewed as a system involving emotional, cognitive, and environmental influences and experiences. The idea here is to gain, enhance, and develop changes in an individual's values, skills, norms, and beliefs.

Hill (2012) postulates that theories of learning benefit teachers in two ways. The first is that they aid them with the vocabulary necessary for the interpretation of concepts required for and when teaching. The second one is that theories of learning help guide teachers in their search for solutions to learning problems. Theories help identify factors that are valuable for problem-solving, particularly in Mathematics learning. There are three core divisions that make up the theories of learning (Opper, 2019; Mamali, 2015), vis; behaviorism, cognitive theories, and constructivism.

Behaviourist theories deal with children's behaviours at school, specifically in class, cognitive theories help explain the learners' brain functions in learning, and constructivism theories see learning in terms of children creating new ideas in class (Vaill, 2011).

Henning, van Rensberg and Smit (2010) cited in Mamali (2015) pointed out that theories are lenses through which researchers position their studies. Theories help formulate hypotheses about researches and how they speak to the real world. They are windows through which researchers observe the world, and hence their studies' orientations. This work was undertaken following the theory of constructivism. This helped explain how teachers prepare learners to be creative in class. That is, children are taught how to analyse ideas and apply them in practical situations to exhibit what they learned at school (Opper, 2019). Thus, learners are taught enumeration and its application through various objects such as stones or seeds. In this case, the constructivism theory plays a critical role in how children learn

Mathematics. Simply put, learning is designed to foster children's cognitive, social and physical development, and environmental awareness (Celik & Guzel, 2019). This is realised when learners are able to interact and manipulate numerical programmes that are critical in their mathematical knowledge growth (Kutz, 2011).

Donald, Lazarus, and Lolwana (2010) as cited in Mamali (2015) reiterate that constructivism views knowledge as people's active construct, and not a merely transferred entity. One would say that constructivism involves the desire and the zeal to succeed. Children are supposed to be proactive in the teaching and learning processes. This means that knowledge is acquired through the construction of ideas and merging them with prior ones. Through their engagement with past experiences, current activities, and classroom discussions, learners are challenged to decipher meaning from their social and physical environments (Donald, 2013; Schunk, 2012). Moodley, Njisane, and Presmeg (2012) point out that given the constructivism position one realises what they understand instead of understanding what they see. Our reflections of the real world and its interpretations thereof show the way we organise our internal ideas (Mamali, 2015). The objectives that underpin constructivism discussion are; to discuss different kinds of learning, to show that the way we learn is also determined by the kind of knowledge we have, to indicate alternatives to the usual one-way communication from teacher to child, and to show that meaningful learning takes place if learners are given an opportunity to learn.

These objectives are in line with this study's aim, given that they speak to Mathematics teaching and learning. In this regard, Moodley (2012); Mamali (2015) established that constructivism helps facilitate engagements between teachers and children as it provides opportunities for the latter to learn constructively. They also established that teaching nurtures and promotes the establishment of enough effective constructions. That is, the teachers' work is to guide the learners and correct them as they seek to understand their surroundings. Moodley (2012) and Mamali (2015) further established that the mind creates knowledge, meaning that the way we understand issues is governed by what we see.

Teaching should be diversified and blended with what learners construct. This would help teachers accept the learners' learning deficiencies, and hence help them accordingly. Van de Walle (2006) noted that constructivism champions divergent views in learning as opposed to rot learning. Learners should be assisted to formulate ideas in relation to what they already know. They should never be thrown under the bus with the hope that they accidentally stumble on new numerical ideas (Mamali, 2015). In addition, teachers should be pivotal in the teaching and learning processes (Celik & Guzel, 2019). Thus, theories of learning were used to understand how

Mathematics teachers in the Luvuvhu Circuit deliver their lessons, how they carter to learners with different learning abilities, and how they help learners develop cognitively, behavioural and socially.

2.3 GLOBAL VIEW

This section discusses the global view on the teaching of Mathematics in general and that of quadratic functions in particular. Literature in this context mainly focuses on Mathematics teaching in general without detailing the dynamics that underpin the quadratic functions teaching in the identified countries. Two countries are discussed in this section. These are the United States of America (USA) and Germany.

2.3.1 The United States of America

Prior to higher education, American students attended primary and secondary schools for a combined total of 12 years. These years are from the first through to the twelfth grade. At the age of six, children in America begin primary school, commonly called "elementary school." They attend for five to six years and then proceed to secondary school (Zeigler, 2019) where they can choose to specialise in Mathematics. Secondary school consists of two programmes. The first is "the middle school" or "junior high school", and the second programme is "high school." A diploma or certificate is awarded upon graduation from high school. After graduating from high school (12th grade), the students may go to college or university. College or university study is known as "higher education (Zeigler, 2019).

America's school calendar usually begins in August or September and continues through to May or June. Most new students begin in autumn, and many schools' academic year is composed of two terms called "semesters" (some schools use a three-term calendar known as the "trimester" system). Still, others further divide the year into the quarter system of four terms, including an optional summer session (Zeigler, 2019). The Obama administration pushed states to adopt the more rigorous academic standards and tests, new teacher evaluations, and pay systems based in part on student test scores and strict improvement models for the so-called "failing" schools. In the twilight of the Obama administration, Congress replaced the No Child

Left Behind with the Every Student Succeeds Act, which enshrined the annual testing requirement but otherwise represented a sweeping rollback of the federal government's involvement in K-12 education (STUDYUSA.com, 2020).

Meanwhile, the Trump administration's biggest-ticket education priority was to expand the school choice – a big tent that includes everything from charter schools to private and parochial schools to school vouchers and education savings accounts. Despite striking out at the federal level, the focus served to expand school choice options in a handful of states (STUDYUSA.com, 2020).

2.3.2 Germany

The German education system entails a well-defined sequence of educational domains. That is, preschool education, elementary education, lower and upper-level secondary education, higher education, and continuing education. The German mandatory schooling begins at the age of six and usually lasts for 12 years. Of the 12 years of schooling, at least nine must be full-time schooling, specialising in Mathematics and other subjects. After their ninth year in school, learners are required to attend a three-year programme of part-time vocational study (Hainmuller, 2003). As a rule, when children reach the age of six, they are obliged to attend primary school. All pupils in Germany enter the grundschule (primary school), which covers grades one to four. In Berlin and Brandenburg, the grundschule covers grades one to six (Euryduce, 2021). These are foundational grades that help decide whether the learners can do Mathematics at high school or not.

Mathematics teaching is emphasised at high school in preparation for Mathematics related specialised courses at tertiary level. As it is, the discussion about the integration and inclusion of learners with specific backgrounds is on-going in Germany. The focus is on two groups (a) learners with disabilities and (b) migrants. In 2009, Germany committed itself to the inclusion of learners with disabilities (Beatner & Pechuel, 2017). These have specialised Mathematics curricula. This shows that Mathematics teaching in Germany is paramount.

2.4 CONTINENTAL VIEW

Generally, Africa's education system follows that of its former colonial masters. That is, countries such as Botswana and Zimbabwe's education system are similar to that of the United Kingdom as the latter was the former's colonial master. Rhodesia's colonial government (now Zimbabwe), for example, created a situation where Mathematics was regarded as the main subject at both primary and secondary schools. The same indoctrination continued after Zimbabwe became independent, and it still continues even today. This section reviews literature concerning the teaching of Mathematics in Botswana and Zimbabwe.

2.4.1 Botswana

Before 2017/18, Botswana's education system was under one Ministry. That Ministry was known as the Ministry of Education and Skills Development (MOESD). However, this was abandoned in 2017/18 when that Ministry reconfigured to form two separate Ministries that oversaw education in the country. The resultant new Ministries are the Ministry of Basic Education (MOBE) and the Ministry of Tertiary Education (UNICEF & the World Bank, 2019). The MOBE is in charge of both primary and secondary education.

Botswana's basic education system was developed to produce critical thinkers, problem solvers, and innovative students. In order to fulfill its aims and objectives, subjects such as Mathematics and the Sciences are prioritised by the MOBE. However, the teaching of Mathematics is currently faced with a myriad of challenges as learners perform poorly in their national examinations, not to mention dropping out of school (Malejane & Diraditsile, 2019). Mathematics Curricula do not cater to children with disabilities, as few disabled children are integrated in regular school classes (Malejane & Diraditsile, 2019). That is, there are limited special education curricula, particularly those to do with Mathematics. As a result, parents are forced to pay large amounts of money in fees to non-governmental organisations if their children with special needs are to get proper Mathematics education (Education Encyclopedia, n.d; Makwinja, 2017).

This has seen the standard and quality of Mathematics education deteriorating because of the high rate of failure at secondary schools (UNICEF & the World Bank, 2019). Public secondary schools are largely overcrowded in Botswana, making Mathematics teaching a nightmare to teachers. In this regard, one would say that the quadratic functions are poorly taught in Botswana's secondary schools. That is, Botswana's public schools lack the resources to effectively teach Mathematics concepts such as quadratic functions (Makwinja, 2017). Furthermore, the challenge is that Mathematics teachers are demoralised as they work under poor conditions and in under-resourced schools (Makwinja, 2017). Given such difficulties, it is not surprising that Batswana learners perform poorly in Mathematics.

2.4.2 Zimbabwe

Zimbabwe's education system, once the best in Africa, now faces immense challenges. Its public financing continues to dwindle in real terms. This has seen school fees soaring beyond many people's comfort. Many teachers, particularly those who specialise in Mathematics and other Science subjects, have left the country for new ventures elsewhere (Singizi, 2008). Those who are still there have low morale owing to low salaries (Singizi, 2008). This has negatively affected Mathematics teaching and learning in the country's secondary schools.

In other words, the quality of Mathematics education in Zimbabwe is hindered by teacher shortages, infrastructural pressure, and the country's economic crisis. Schools also face capacity challenges, including the double session schooling commonly known as “hot seating”, and the overcrowded classrooms (K12 Academics, 2004-2012). “Hot seating” means that Mathematics classes are conducted in the morning and others are done in the afternoons. These methods enable more students to attend school, but quality declines because students are given less attention and time to learn Mathematics. Furthermore, the quality of Mathematics teaching is also impacted by the lack of trained Mathematics secondary school teachers. This is compounded by the fact that the majority of Zimbabwe's Teacher Training Colleges train primary school teachers, leaving fewer opportunities to meet the demand for trained secondary school teachers (K12 Academics, 2012).

2.5 THE LEVEL OF QUADRATIC PROBLEM-SOLVING TEACHING SKILLS DISPLAYED BY TEACHERS IN TEACHING QUADRATIC CONCEPTS

This section makes an in-depth review of the literature concerning the level of quadratic problem-solving teaching skills displayed by teachers in teaching quadratic concepts. The section is divided into themes for easier review. The themes are informed by the study's first objective as provided in this Chapter's introductory section. The idea is to help achieve the said objective through reviewing literature in relation to these themes.

2.5.1 Quadratic problem-solving teaching skills as reflected through cooperative learning

Cooperative learning helps improve the learners' performances in several subjects across all grades. Yusof and Zakaria (2010) as cited in Mamali (2015) concluded that group work assists learners to gain higher-order cognitive skills that include synthesis and analysis, in addition to increasing their attitudinal skills. Cerbito (2020) added that a conducive learning environment should afford the learners the opportunity to interact with others as this makes them learn better. According to TIMSS (2007), a small-group is good for learners to open up as they discuss with others. Cerbito (2020) reported that cooperative learning is suitable for learners who are eager to improve themselves.

Working in groups in class helps learners develop their teamwork skills. Their communication skills are enhanced as they cooperate in learning. Opper (2019); Briley (2012) as cited in Mamali (2015) noted the cooperative learning approach's objectives that include the learners' active involvement in the teaching and learning process, the learners' encouragement to work together, and providing learners with opportunities to talk freely. Esquer, Robles, Cosmes, and Ansaldo (2017) revealed that cooperative learning is an efficient learning technique as it increases the learners' pass rate in quadratic functions (Celik & Guzel, 2019). Mosibudi (2012); Fares (2018) asserted that group work gives learners the chance to develop their interpersonal, social, and psychological skills. It must be stated that its benefits, however, would be realised after some time. The issue is that its short-term application results in bad outcomes.

2.5.2 The Mathematics skills approach

Using the skills approach leads to learners memorising basic skills (Celik & Guzel, 2019). The assumption here is that numerical understanding is a collection of useful information (facts, rules, and formulae) (Mamali, 2015). Makamure (2016) emphasised that since learners rarely participate in real numerical thinking, the technique of the skill is not inquiry-based, as it involves a repetitive practice. In the skills approach teachers purely tell learners to add figures (Mugisha, 2012). Sorensen (2021) revealed that learners do various calculations following the rote learning technique. This is done without context (a reason) at a symbolic (abstract) level (Mugisha, 2012). The skills articulation is neither purposeful (teaching builds on the learners' interests and their need to learn Mathematics), nor meaningful (Diaz & Poblete, 2018).

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2.5.3 Mathematics problem-solving approach

Sorensen (2021); Mukono (2015); Mamali (2015) established that the problemsolving approach deals with the numerical thinking progression, that is, reasoning and problem-solving. This approach estimates that Mathematics requires thinking, investigation and searches for patterns in solving problems (Holm & Kajander, 2012). Learners on the one hand are regarded as intuitive thinkers and thus have inadequate information (Celik & Guzel, 2019). On the other hand, they are curious creatures that were actively designed to holistically understand Mathematics (Celik & Guzel, 2019; Fried, 2011). The Mathematics instruction aims at immersing numerical novices in inquiry in order that learners mature in thinking and incidental discovery (Peel, 2020) thereby developing a complex understanding of the subject (Celik & Guzel, 2019).

2.5.4 Investigative Mathematics approach

According to Peel (2020); Baroody (2003), this approach addresses the memorisation of skills and the development of numerical thinking. As with the conceptual technique, Mathematics is seen as a network of skills and concepts (Celik & Guzel, 2019). Also, in line with the problem-solving style, the investigative system is a process of inquiry (Celik & Guzel, 2019). The learners actively construct thoughtfulness, which is mediated, guided, and urged by the teacher through the planned lesson activities (Depaepe, Verschaffel & Kelchtermans, 2013). In this approach, the teacher mentors learners as they meaningfully construct procedures and concepts to increase their numerical thinking (Peel, 2020).

Sunbul and Gordesli (2021); Mosibudi (2012); Makamure (2016) indicated that teachers use indirect means to help learners gain knowledge. For example, teachers might assist learners to reinvent procedures for addition purposes (Depaepe et al., 2013). Teachers motivate learners to modify procedures to solve problems (Makamure, 2016). This is more of the use of manipulatives (Celik & Guzel, 2019). Grade 11 learners are urged to symbolically present the problem and its informally determined solution using shortcuts and concrete procedures (Beilock, Schaeffer & Rozek, 2017).

2.5.5 Use of learners' prior knowledge to enhance problem-solving teaching skills in Mathematics

Christie and Morris (2019); Cobb, Yackel, and Wood (2009) assert that the learners' knowledge is taken as understanding the characteristics (conceptions, preconceptions, misconceptions, and learning difficulties) of a certain group of learners, establishing a classroom environment, and planning lessons to meet their needs. Bajana (2019) thinks that learners are not clean slates in class. They have particular prior knowledge of what is taught to them in class (Christie & Morris, 2019). As they learn Mathematics, what they make of the topic area might be different from their teacher's expectations of them. This means that teachers might equally be unaware of the learners' experiences.

Bajana (2019) said that teachers should come up with a teaching strategy that enables them to deliver lessons in local languages. From a constructivist standpoint, learning entails interpreting phenomena, situations, and events (Christie & Morris,

2019) through interpreting the learners' existing knowledge. Alvior (2014) established that teachers who understand the subject content are good in class, yet this is not enough to have them labelled as effective teachers (Makamure, 2016).

In addition, teachers should know how to teach Mathematics concepts to a diversified group of learners including addressing their queries, the media adopted for lesson delivery, and engaging them as different learners (Bajana, 2019). Ruli et al. (2018) assert that since PCK is reviewed as knowledge concerning the teaching of particular subject content, the pedagogical knowledge is inadequate for effective teaching and learning programmes. Adler and Pillay (2017) pointed out the inadequacy of teachers as they have poor knowledge about the learners' conceptions of ideas. That is, teachers were provided with samples of the learners' omissions and requested to respond to those. But, they decided to narrate the proper terms that assist in removing the learners' mistakes (Adler & Pillay, 2017). In this study, the teachers' familiarity with the learners' understandings, their subject content levels, and their lesson delivery approaches (Klassen et al., 2021) were investigated through interviews, observations, and lesson plan analysis.

Adler (2015) admitted that learners have varied knowledge and interests about the Mathematics topics taught in class. Celik and Guzel (2019) observed that having the topic's prior knowledge enhances the new learning experiences. The result is that learners could misunderstand concepts (Ruli et al., 2018). When Grade 11 teachers select the strategies to use to teach learners to understand Mathematics, they first reflect on the latter's prior knowledge (Ozaltun & Bukova, 2019). As teachers change the subject content to suit the learners' cognitive levels, they should take into consideration the already known learner misconceptions (Ambrose, 2014). This helps them have an insight into the learners' thinking, thereby building on the best possible means to teach effectively (Barry & Lechner, 2009). Grade 11 teachers should implement a baseline assessment to determine the learners' previous understanding of the topic. If teachers are cognisant of what learners know, they easily bridge the gap between the known and the unknown (Klassen et al., (2021). This goes a long way in helping teachers clarify misconceptions that clog the learners from understanding new information (Briley, 2012).

To properly investigate the learners’ misconceptions regarding a given topic, teachers should be first clear about what those misconceptions are. In short, these are aspects of wrong knowledge that arise from the learners’ previous learning experiences, both inside and outside of the classroom (Ruli et al., 2018). Teachers with a poor understanding of the subject matter in Mathematics are part of the problem as well (Bajana, 2019).

Bad reasoning creates consistent problems to solutions (Bajana, 2019). Misconceptions are generally formed when new lessons are not compatible with the learners’ prior knowledge about the topic. Similarly, due to their flawed content, misconceptions negatively impact the learners learning new concepts. Klassen et al. (2021); Franke and Kazemi (2013) indicated that good Mathematics teachers have an exceptional knowledge about how learners learn the subject. They understand the theories necessary to learn Mathematics. These educators know the learners’ Mathematics development, including its sequences, appropriate representations, models, and language (Ozaltun & Bukova, 2019). Good teachers know the learners’ common misconceptions about particular topics, and hence they structure their lessons such that the misconceptions are tackled (Flockton & Cunningham, 2020; Goodnough et al., 2009). In these teachers’ lessons, discussions are encouraged through learners justifying what they provide as responses to topical issues (Ozaltun & Bukova, 2019). According to NCTM (2020), eliminating misconceptions requires that teachers teach proper concepts that clearly render the learners' faulty conceptions invalid. The adopted teaching method should include clarifications and activities that lay bare the said misconceptions.

Confronting ideas through class discussions is profoundly required if learners are to internalise what they are taught, in the process eradicating their misconceptions (Flockton & Cunningham, 2020). Shulman’s (1986) cited in Hine (2015) conception of PCK is knowledge representations of the subject content and understanding of specific learning difficulties. These elements dovetail and should be flexibly applied. The more representations there are for teachers, the better for them to recognise their learners’ learning problems, and the more they effectively deploy their PCK

(Flockton & Cunningham, 2020; Shulman 1987, cited in Kahan, Cooper & Bethea, 2013).

Bajana (2019) posits that teachers must understand the possible difficulties learners might experience in each Mathematics topic to be taught. This enables them to prepare for possible clarifications (Mosibudi, 2012). They should also give examples that make learners to easily access the content of what is being taught. The knowledge of such difficulties also allows teachers to thoroughly prepare for prior content assumptions (Mukono, 2015; NCTM, 2020). Learning difficulties may arise due to the language of instruction in Mathematics (Kahan et al., 2013).

2.5.6 Teachers' levels of quadratic function problem-solving skills

The outdated teaching practices and the lack of basic content knowledge result in poor teaching. "A large number of under-qualified or unqualified teachers who teach in overcrowded and non-equipped classrooms also exacerbate the poor standards" (Mamali, 2015:17). In turn, these factors create a new generation of teachers who perpetuate the mediocrity cycle (DBE, 2012). The National Teacher Education Audit (1996) and the Mathematics and Science Audit (1997) provided factual and statistical revelations about teachers and teaching in these areas. Whilst policies and programmes are generally produced, very little happens at systemic levels to address challenges in the provision of quality Mathematics teachers (Bajana, 2019).

To Bajana (2019); NCTM (2020) the Mathematics Audit shows that more than 50% of Mathematics teachers have no formal subject training. This training inadequacy was identified to be prevalent in the GET phase (DBE, 2012). An estimated 8 000 Mathematics teachers need specialised training to address their shortcomings (DBE, 2012). Bajana (2019) added that another concern is those very few people who pass Mathematics choose teaching as a career. Consequently, this becomes a vicious cycle as few teachers study Mathematics Education at university, leading to the shortage of Mathematics teachers (DBE, 2011).

Flockton and Cunningham (2020); Makamure (2016) said that teachers' lack of specialised training in quadratic functions results in schools' failure to offer Mathematics. Even those that offer it do not have proper facilities and equipment to promote its effective teaching and learning. Thus, teaching quadratic functions has greatly suffered (Mutumbara et al., 2020). To overcome the shortage of qualified Mathematics teachers, a number of initiatives and programmes were developed at both national and provincial levels in collaboration with higher education institutions (Frydaki & Mamoura, 2011).

2.5.7 Quadratic function problem-solving teaching skills among those who teach quadratic functions

Karnasih and Soeparno (2009) claimed that Mathematics is no longer seen as a collection of abstract concepts and procedural skills to be mastered but as a system of human sense-making and problem-solving initiatives based on reality's numerical modelling. In this case, teachers should not teach through rote learning. To understand Mathematics, teaching concepts using the language best understood by teachers is critically essential (Mutumbara et al., 2020).

Passive learning is now outdated, given the reformed Mathematics curricula (Mutumbara et al., 2020). Teachers who still use this approach have become a stumbling block to teaching Mathematics, further compounding the learners' Mathematics problems (Mugisha, 2012). The answer to this is to have such teachers undergo in-service training. Fares (2018) explains that in Mathematics, unlike in other science subjects, objects do not have tangible existence. That is, Mathematics can only be symbolically presented (Flockton & Cunningham, 2020).
Nonetheless, in Mathematics classes, teachers use counters to develop the learners' addition and subtraction skills.

In so doing, we should not lose sight of the fact that this symbolic representation requires the use of the language that is understood by teachers (Fares, 2018). The teacher's role, in this case, is significant (Kerans, 2014). Here, the focus must not be on symbols and what they mean, but on the activities that symbolise meaningmaking

(Maree, 2011). To this end, improperly trained teachers become a hindrance to excellent results (Mutumbara et al., 2020). The situation is worsened by the use of the second language in teaching and learning (Good & Lavigne, 2018). This is a major impediment to black South African teachers (Cerbito, 2020).

2.6 THE FACTORS THAT AFFECT LEARNERS' PERFORMANCE IN QUADRATIC FUNCTION

This section provides an in-depth review of the literature in order to address the above objective. This is done through the themes that follow below.

2.6.1 Teachers' Mathematics knowledge

Cerbito (2020); Makamure (2016) agree that teachers should be knowledgeable about what they teach if there is to be effective teaching in class. Mji and Makgato (2016) assert that we see Mathematics teachers as teachers with a lot of knowledge about the subject. Yet, not only Mathematics knowledge is tantamount to efficient teaching (Makamure, 2016). Mutumbara et al. (2020) reiterated that teachers need knowledge in order to be effective teachers. They should understand worthwhile tasks, orchestrate discourse, and create a conducive environment for teaching and learning (Fares, 2018).

Teachers should be able to use the teaching language effectively if they are to succeed in transferring knowledge to their students. Their failure to do so compounds the learners' problems. Mutumbara et al. (2020) argue that the teachers' level of knowledge is paramount for effective Mathematics teaching. Flockton and Cunningham (2020) concur that the teacher's pedagogical content knowledge is necessary if one is to be regarded as a good teacher. This means that teachers should not only have academic knowledge but should be able to impart such knowledge to their learners. Thus, the teachers' thoughts and knowledge should be clearly articulated. Sorensen (2013) postulated that Mathematics teachers require a new kind of professional knowledge that mixes Mathematics content knowledge and pedagogical knowledge.

Cerbito (2020) reflects that lessons are major factors that influence learning outcomes. The teachers' beliefs, understanding, and practices in class have a bearing on lesson outcomes (Sorensen, 2013). In other words, teachers might trust that learners learn better through direct instruction. But, if the teacher's subject knowledge is bad and limited, what learners learn is affected (Fulgar, 2020). Given this scenario, it is fair to say teachers should have good knowledge of what to teach.

Mugisha (2012) observes that teachers should have good knowledge of the children's previous knowledge to avoid teaching learners what they already know or what is above their level of comprehension. Lastly, teachers should use proper teaching methods to benefit learners (Zerpa et al., 2009). That is, a teacher might be a genius in Mathematics but if they have no proper teaching methods, they would not be able to address the learners' shortcomings.

Mutumbara et al. (2020) argue that bad conceptual knowledge prohibits the successful acquisition of Mathematics skills. For learners to understand Mathematics with ease, they should clearly understand its concepts. Cerbito (2020) adds that teachers who pay attention to learners' conceptual weaknesses could enhance the learners' reasoning capacity. If teachers understand Mathematics concepts, chances are that they have better control and direction of the learning activities (Makamure, 2016). Cerbito (2020) acknowledges that appropriate Mathematics activities could be expanded to the learners' level of understanding". It is essential to understand them to properly present lessons.

According to Setati (2009), the Asian learners' higher Mathematics achievement levels relative to their American peers is because the former's Mathematics classroom lessons explicitly teach conceptual knowledge than the latter's. Without conceptual knowledge, children largely lack an understanding of fundamental Mathematics problems (Mutumbara et al., 2020). Tsanwani (2009) adds that knowledge is necessary for the flexible and adaptive application of numerical and arithmetic knowledge. As such, learners should be active participants in the teaching and learning process. Zakaria (2010) provides that learning might not take place until the numerical and arithmetic knowledge becomes beneficial to learners.

2.6.2 Learning environment

Sorensen (2021) asserts that a learning environment includes, inter alia, teachers, the curriculum, the teaching media, and learners. The school environment that includes infrastructure and facilities also impacts academic performance. Mamali (2015) indicated that classrooms in rural schools are often in a poor state. Given this poor state of schools, one would say that effective teaching and learning are curtailed. The school's physical appearance is also important in determining the teacher's efficacy in class (Kahan et al., 2013). One can, therefore, state that learners in under-resourced South African schools are educationally disadvantaged as they do not have access to quality education (Cerbito, 2020).

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2.6.3 School and class size

Jones (2012); Mamali (2015) indicated that the relationship between the class size and the learners' achievement is not properly defined for classes with 20 or more learners. Class sizes have been seen to impact the learners' success. Kirk (2010) avers that big schools negatively influence the learners' academic progress. Conversely, small classes of below 20 learners are advantageous for underprivileged learners (Sunbul & Gordesli, 2021; Makamure, 2016). In this respect, Jones (2012) argued that small schools have the capacity for a wide range of interactions but inhibit the teachers' specialised qualities.

2.6.4 Curriculum

The quadratic functions curricula over-emphasise the memorisation of facts while under-emphasising their understanding and application. Mutumbara et al. (2020) reveal that there are many concerns raised in literature about the current quadratic functions curricula. Mukono (2015) raises the fact that memorisation must be conceptualised and applied so that learners could successfully apply what they learn in class. The concerns are not that learners should never learn to compute (Mutumbara et al., 2020) but to also critically analyse quadratic function problems to have effective solutions (Cerbito, 2020). This requires that they make sense of complex Mathematics concepts (quadratic functions) (Sunbul & Gordesli, 2021; Depaepe et al., 2013).

2.6.5 Attitudes and beliefs

According to Kerans (2014), attitudes and beliefs are important in achieving the good quadratic functions pass rate. Kerans (2014) argues that the learners' attitude towards quadratic functions may either positively or negatively influence their confidence in the area. Sorensen (2021); Moyana (2016); Mosibudi (2012) came up with an attitude scale to measure the learners' attitudes towards quadratic functions. It is believed that the teacher's attitude towards quadratic functions affects the learners' attitudes as well. When concrete materials are used in quadratic function lessons both teachers and learners reported that they enjoy quadratic function lessons (Sorensen, 2021; Romberg, 2010).

The learners' positive attitudes in quadratic functions would enable our country to produce the required number of engineers and scientists (Cerbito, 2020). Their positive attitudes towards quadratic functions make them do well here. Makamure (2016) stated that this is one of the many ways that teachers positively impact attitude in a Grade 11 Mathematics class. Because quadratic functions achievement is closely linked to attitudes (Mosibudi, 2012), it improves that attitude (Cerbito, 2020). Learners with positive attitudes towards their teachers achieve highly. Keran

(2014) found that in all grades, the learners' relatedness with teachers determines their frequency in seeking help from them. Girls and boys in middle school have different attitudes towards quadratic functions (Sunbul & Gordesli, 2021; Makamure, 2016).

2.6.6 Peer pressure

Klassen et al. (2021); Sorensen (2013) identified peer pressure as one of the most influential factors in the learners' achievements in quadratic functions. It affects all learners, regardless of their success or lack thereof. Esquer et al. (2017) point out that learners are ridiculed by their peers for taking challenging quadratic functions while other peers encourage their friends to take up academically challenging quadratic functions. In this regard, Klassen et al. (2021) noted that peers' attitudes towards quadratic functions either positively or negatively influence the learners' confidence in the subject.

2.6.7 Enjoyment and ability

Learners think that learning Mathematics requires the memorisation of equations and formulae (Zerpa, Kajender & Van Barneveld, 2009). Teachers in this study made a distinction between quadratic functions and what they experience in class, and the abstract quadratic functions (Esquer et al., 2017). Creativity, problem-solving, and discovery are part of what teachers should teach in class (Zakaria & Zaini, 2009).

Celik and Guzel (2019) reveal that learners who think less of their quadratic function abilities attribute their success more to luck and their failures to lack of ability, whereas those who consider themselves good at quadratic functions attribute their success to their ability. In a study of Grade 10 and 11 quadratic functions classes, Bajana (2019) explored the relationship between the learners' beliefs about quadratic functions, their sense of quadratic functions as a discipline, and their relationship with it, and their quadratic function performance (Diaz & Poblete, 2018). Learners who enjoy and understand the quadratic functions perform better than those who hate it. Celik and Guzel (2019) stated that learners who enjoy while learning quadratic functions achieve higher scores.

2.6.8 Learner conceptual knowledge

School-age learners are described as having impoverished conceptual understanding, leading to the generation of flawed and illogical procedures for solving multi-digit subtraction problems, decimal fractions, and other Mathematics tasks (Celik & Guzel, 2019). Thus, it is important for learners to be taught concepts so that they easily understand Mathematics. Klassen et al. (2021); Zerpa, Kajender, and Van Barneveld (2009) note that conceptual knowledge is understanding the principles that govern the interrelation between pieces of knowledge in a domain. Diaz and Poblete (2018) define procedural knowledge as action sequences that help solve problems. It is important that learners are taught these principles such that they easily understand them. To Kennedy (2019); Schoenfeld (2008), conceptual and procedural knowledge is what learners learn in their course of development and they develop in tandem rather than independently.

2.7 CHALLENGES FACING TEACHERS IN TEACHING QUADRATIC-FUNCTIONS IN GRADE 11 MATHEMATICS

Recent research agrees that students have difficulties in learning quadratic functions (Celik & Güzel, 2019; Ruli, Pradawanto & Mulyana, 2019), which has its origin not only in the cognitive domain but also in the affective domain. Some researches in cognitive domain proposed to relate to records of semiotic representations and technological environments (Bajaña, 2019; Esquer, Robles, Cosmes, & Ansaldo 2017; Farez, 2018; Gomez-Blancarte, Guirette, & Morales-Colorado, 2017; Özaltun & Bukova, 2019; Peralta-García, Encinas-Pablos, & Cuevas-Salazar, 2019). Studies of quadratic function and problem solving are less common.

In the affective domain, it is also rare to find studies of students' affections and problem-solving. However, there are several studies on the relationship between the teacher's attitude and the student's academic performance in Mathematics (Beilock, Schaeffer, & Rozek, 2017; Chapman, 2013; Cerbito, 2020; Good & Lavigne, 2018).

At present, the emphasis is placed on the need to develop skills for problem-solving and the development of creative abilities in Mathematics (Díaz & Poblete, 2018). There is a need to recognise and anticipate errors that are part of the productions of most students. Such students constitute a stable element in the processes of teaching and learning Mathematics at all levels of the education system. Quadratic functions play a key role in the development of Mathematical concepts since they cross a range of mathematical content domains, including algebra and geometry (NCTM, 2020).

On the other hand, Mathematics teachers' understanding of quadratic functions is critical to students' success in Mathematics. There seems to be an agreement that for many high school students, solving and understanding quadratic functions can be conceptually challenging because of the need to make connections between various representations of the function, as well as the connections between various ways in which quadratic equations can be expressed (Didis, Bas, & Erbas, 2011; Kilic, 2011).

For many students and teachers, mistakes are associated with negative feelings. According to the American Psychological Association, feelings that affect a person's mood and emotional reaction can be called affection, and the attitude towards Mathematics is an example of an affective state (Berger, Mackenzie, & Holmes, 2020). For Cerbito (2020) attitude refers to a person's way of thinking, acting, and behaving. It has relevant implications for students, teachers, the immediate social group, and the whole school system (Mensah, Okyere, & Kuranchie, 2013). Attitudes can affect behaviour that influences what the student selects from the environment, how he/she reacts to teachers, to the materials being used, and to other students. When students are approached with non-routine Mathematics problems (Díaz, Belmar, & Poblete, 2018) their reactions often include a lot of emotions. If the problem-solving time is long, the emotional responses can be very intense.

In my fifteen years of teaching Grades 8 – 12 Mathematics, I have realised that learners join the high school with lots of setbacks in quadratic functions. For example, regardless of the learners' ability to identify quadratic function figures/shapes, they are however unfamiliar with their properties. Ball, Lubienski, and Mewborn (2011) identified the difficulties associated with the transition from primary to high school in the United States of America.

The teachers' most important role in Mathematics is to accord learners the foundational knowledge required in order to help them develop their academic acumen (Kutama, 2012). Kelly (2008) reiterated that qualitative research has established that Mathematics teachers in secondary schools are critical resources as far as the learners' acquisition of knowledge is concerned. That is, schools deal with physical facilities, class size, curricula, instructional strategies, and other resources that influence learners' acquisition of knowledge.

Kennedy (2019); MA (2009); Karnasih and Soeparno (2009) suggested that the improvement in the teaching of quadratic functions in secondary schools is enhanced by a number of factors. These include, among others, the learners' capabilities and the teachers' teaching methods (Ozaltun & Bukova, 2019). Also included here is the pedagogical knowledge relevant in Mathematics teaching and, the principals' and teachers' pessimism. The teaching methods, assessment styles, and the background knowledge's shortage influence the learners' performance in Mathematics. The teaching level and the learning activities' quality impact the learners' performances (NCTM, 2020). The learners' task quality such as test scores, their intellectual attitude, structural quality, prior knowledge, parental influence, and the home environment can influence their performance as well (Meyer & Kloehler, 2009). The literature emphasises the existing quadratic functions curricula (Mamali, 2015). The concern is that learners should not only learn to compute but also to develop critical analysis in quadratic formula issues for effective solutions.

There is a belief that primary schools focus on identifying and giving names to quadratic function shapes and stating what they symbolise. This is in addition to developing skills vital to measure and construct shapes using the compass and protractor. Akhtar (2014) added that the curricula in question are haphazard, thereby complicated. Teachers who teach in secondary schools take time to teach quadratic functions (Mutumbara et al., 2020). They teach them using the traditional transmission model. This gives problems to learners in their understanding of concepts, particularly in as far as the in-depth knowledge of quadratic functions is concerned (Kennedy, 2019; Bekdemir, 2010).

2.7.1 Teaching Mathematics effectively

Kennedy (2019); Hill *et al*. (2016) acknowledged that effective teaching should be evidenced by examining the quality of opportunities teachers give to learners in class. Mathematics teaching should be geared to assist learners to learn the subject (Bekdemir, 2010). That is, teaching Mathematics effectively would culminate into a variety of learner outcomes. One would say that Mathematics teaching relies on the teachers' expertise in combination with the consolidated practice of important skills (Fried, 2011). But, this approach is defective in that the slow learners' expositions are not fully accommodated (Mamali, 2015). Thus, several techniques are not properly considered, and hence are easily forgotten (Hill, Rowan & Ball, 2016).

The educationists, theorists, and psychologists' values should be informed by the need to come up with problem solvers, and thus the call for the teaching techniques that are action-orientated to enhance their competencies (Good & Lavigne, 2018). In view of this research, given the constructivism theory, Mathematics teaching should be defined. Teaching Mathematics is only effective if it assists learners to get related Mathematics skills and knowledge for positive outcomes (Hill et al., 2016). In this case, the success of Mathematics teaching is centred on the learners' involvement in accumulating knowledge by exploring, solving, discussing, and experiencing what is taught (Kennedy, 2019; Johnson, 2010). This gives the impression that teaching Mathematics effectively requires the conceptualisation of themes taught.

This calls for the alignment of Mathematics pedagogy with the shift away from the traditional emphasis on rules to manipulate symbols to techniques where learners actively engage with Mathematics (Karnasih & Soeparno, 2009). To measure the effectiveness of the teaching and learning process, learners should know, understand and demonstrate that which they learned (Good & Lavigne, 2018). In South Africa, Grade 11 learners perform poorly in Mathematics in both local and international examinations, notwithstanding the educational reforms undertaken by the post-apartheid government.

2.7.2 Learners' mathematical thinking

The learners' mathematical reasoning informs how instructions should be modified to meet their expectations with the view to improving their performance in the context of higher mathematical standards (Moyana, 2016). Learners' Mathematics reasoning includes how they understand the subject in terms of what they apply in problematic situations (Mamali, 2015). Their Mathematics representations, arguments, and conceptual understanding should be well articulated (Peel, 2020). These could only be apparent through the learners' creativity, their actions, and comments, and the focus on what they know, can do, and realising what is useful and productive to them. These depend on the teachers' listening skills, their observation abilities, and making sense of their actions.

Teachers' understanding of their learners' reasoning gives them the foundation that informs and guides their plans to help learners make sense of Mathematics (Peel, 2020). Mathematics teachers' knowledge of how learners reason mathematically is a key component of their PCK (Moyana, 2016). Also, teachers should know their content, and most importantly, how particular mathematical concepts are taught.

2.7.3 Challenges encountered by learners in learning quadratic functions in a second language

The use of a second language in teaching Mathematics at the Grade 11 level creates problems for learners. English use in lesson delivery at school has been proven to be a stumbling block for black learners in mastering Mathematics at all levels of their schooling (Peel, 2020). Consequently, this has negatively affected Grade 11 learners in understanding quadratic functions as this encompasses the reading and understanding of instructions (Mukono, 2015).

English as a medium of instruction in black schools has its origins from the 1976 Soweto Uprising (Moyana, 2016). The idea was to make learners communicate with white people who owned the means of production at that point and required black labour (Peel, 2020). Consequently, this has consistently and persistently proven detrimental to the learners' success in Mathematics (Moyana, 2016). Malcom, Keane, Hoohlo, Kgaka, and Oven (2010) as cited in Makamure (2016) opine that language-induced hiccups prevent excellence in quadratic functions. The said problems hinge on English, communication problems, and Mathematics language.

Modern teachers' application of the constructivist views when teaching Mathematics has helped reduce the schools' failure rates (Mamali, 2015). Infusing the teaching methods with constructivist views impact the language used when teaching quadratic functions (Peel, 2020), as this entails speaking with learners. That is, class discussions are done in foreign languages least understood by black learners.

2.7.4 Teachers capacity in teaching Mathematics

Mamali (2015) is of the view that South Africa has many ways that lead to one obtaining a qualification. It should be emphasised that teachers are not qualified as curricula designers and assessment strategists (McGarr, 2020). In this respect, there is no qualified expansions for them (Diko & Feza, 2014). Hungary, for example, faces a teacher shortage in this regard. The country has a low number of Mathematics teachers. For example, their teachers undertake full-time three to fouryear degree programmes, with education the major focus in their studies (Mukono, 2015; Adler, 2015). They also have another chance to do their studies through a subject-oriented degree. Adler (2015); Makamure (2016) revealed that teachers with subject-specific degrees are needed in every country. This is to say that teachers who further their studies are recognised in South Africa. Mamali (2015) asserted that quality training is also important. Principals and Mathematics HoDs fail to spread duties to teachers as expected. This has seen unqualified teachers handling Mathematics lessons (Mamali, 2015). This means that only those whose main subject was Mathematics at university should teach it (Adler, 2015).

2.8 TEACHER-RELATED CHALLENGES WHEN TEACHING QUADRATIC FUNCTIONS

The teacher's knowledge and command of the subject are important in the learners' performance. Most teachers do not enjoy teaching quadratic functions. As a result, they do not spend more time doing that. Maree (2011) stated that one of the most important factors in developing the learners' quadratic functions ability is the teachers' attitude towards it. McGarr (2020) emphasise that the learners' thinking is important while the teachers' knowledge is also critical to their good performance in Mathematics.

2.8.1 Teacher attitude towards quadratic functions

In quadratic functions, one area of focus has been on the teachers' beliefs and attitudes towards the concept. Mamali (2015:55) observed that "the practice of teaching quadratic functions depends on a number of key elements such as the teachers' mental content and schemes, particularly the system of beliefs concerning quadratic functions and its teaching and learning; the social context of the teaching situation, particularly its constraints and opportunities, and the teachers' level of thought process reflection".

2.8.2 Teachers' attitude towards learners in quadratic functions

The issue of attitude towards learners in quadratic functions is extensive (McGarr, 2020). One of the most important factors in developing the learners' quadratic functions ability is the teachers' attitudes towards learners. Mevarech (2012) stated that it is not only the teachers' beliefs about the quadratic functions and its usefulness that are important but also that the teachers' beliefs about their learners' ability to do quadratic functions have an influence on how they teach and how learners learn.

2.8.3 Teacher quality

Jones (2012) maintained that the way learners are educated can only be changed if the way teachers are educated is changed first. Opper (2019); Jones (2012) assert that teachers should be prepared for a new life in the classroom, school, and its systems. The teachers' continued education in quadratic functions should give them the opportunity to examine (Mamali, 2015) and "revise their assumptions about how it is taught, and how learners learn it" (Kirk, 2010:56).

2.9 CHALLENGES THAT HINDER THE LEARNERS' PERFORMANCE IN QUADRATIC FUNCTIONS

Opper (2019); Karnasih and Soeparn (2009) pointed out that there are some factors that influence the teachers' effectiveness namely; their teaching strategies, beliefs, and the general classroom practices that provide an immediate learning environment. Mamali (2015) asserted that teaching strategies can be classified in several ways, that is, the teacher-centred or learner-centred. The teacher-centred strategies are those where the teacher has direct control (Choi, 2019). The learnercentred strategies are when learners play an active role.

2.9.1 Learners' desire to explore the quadratic function

The new Mathematics teaching approach focuses on problem-solving, quadratic functions reasoning, justifying ideas and making sense of complex situations and independently learning new ideas. Quadratic functions teaching can be traced backwards to the traditional teaching methods' failure to impact the curricula and the emergence of new approaches to the scientific study on learning. Basic to this was the standard-based approach to the "what and how" of quadratic functions teaching (Choi, 2019). Learners should be able to write and enumerate quadratic functions concepts, demonstrate, draw and participate in formal quadratic functions (Meyer & Kloehler, 2009). The Principles and Standards for School Mathematics as published by NCTM (2000) developed a comprehensive school Mathematics programme. Learners must be given opportunities to solve complex problems, formulate and test Mathematics ideas to draw conclusions. The idea behind the standards-based approach to quadratic functions is the standards developed by the National Council of Teachers of Mathematics (Jones, 2012).

2.9.2 Mathematics instruction and assessment

If teachers understand these standards and how they are assessed, they would be able to plan and adjust their teaching methods properly. Mullis et al. (2010) realised that the impact of standards in establishing external assessment expectations is profound. The assessment strategies are characterised by traditional or natural alternatives. Effective assessment practices are important in supporting Mathematics instruction that result in improved learner performance. Choi (2019); Sorensen (2013) reveal that the teachers' use of assessment when teaching determines the learner's achievement. This must be performance-based, with the use of multiple strategies with open-ended assessment (Schneider & Stern, 2008).

2.9.3 Standards-based Mathematics

The standards-based teaching in quadratic functions is meant to identify what learners ought to learn at every level. Standards provide more than a curriculum framework as they delineate the skills, concepts and knowledge that are to be mastered (Zakaria & Zaini, 2009). The varied and continuous assessment is designed to evaluate both the learners' progress and the teacher's effectiveness (Zakaria & Zaini, 2009). The implementation of a standards-based quadratic functions curriculum has its challenges though.

2.9.4 Quadratic functions best practices

The effective strategies for quadratic function instructions include rotating strategies that appeal to the learners' dominant learning styles, flexible grouping, individualising instruction for struggling learners, compacting tied assignments and, singular projects and adjusting question levels (Kutama, 2012). Schoenfeld (2008) suggested that when applied appropriately, the long-term use of manipulative materials increases the quadratic functions pass rate and improves the learners' attitudes towards the Mathematics.

Zerpa et al. (2009) gave a list of important principles concerning the quadratic functions teaching and learning. The use of manipulative materials helps learners understand Mathematics concepts and processes, increasing their thinking flexibilities and gives tools for problem-solving (Christie & Morris, 2019; Moyana, 2016). This list includes "the expectations that teachers know what learners need to learn based on what they know, teachers ask questions focused on developing conceptual understanding, experiences and prior knowledge (Christie & Morris, 2019). This provides the ground for learners to effectively learn Mathematics and it justifies the chosen problem solving strategies (Tsanwani, 2009). Mamali (2015) indicates that teachers who use manipulative materials must frequently intervene to ensure a focus on the underlying quadratic function ideas, must account for the contextual distance between the manipulative materials being used and the concept being taught, and take care not to overestimate the instructional impact of their use.

2.10 CONCLUSION

The learners' performance in quadratic functions is affected by physical structures that are in bad condition. That is, some educational media are not available at school. The reviewed literature shows that the main challenges facing teachers in teaching quadratic functions in Grade 11 at the Luvuvhu Circuit schools include the way newly-appointed teachers are trained and the fact that some teachers are poorly qualified to teach at high school. The subject advisors' adequate roles, compounded by their inadequate training as well, and the constant changes in the curricula confuse teachers. This concerns the teaching strategies or methodology that may be used to teach quadratic functions, and the teachers' effectiveness in class. The teachers' and learners' attitude towards quadratic functions is also influenced by the same factors. There is also the shortage of Mathematics teachers as they leave the teaching profession for jobs in the private sector. Chapter three illustrates the research design and the methodology adopted for this study.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

Chapter three discusses the research design and the research methodology adopted for this study. Also outlined is the research paradigm this study followed, that is, the quantitative research paradigm (Leedy & Ormrod, 2012). This study is underpinned by the positivism paradigm because it used the quantitative research design. The reasons why the said research paradigm was chosen are provided. In addition to these, the data collection methods and the ethical issues observed herein are discussed as well. Also given in this Chapter is the data analysis technique. That is, this Chapter explains the processes followed when collecting and analysing data. Thus, it describes its adopted methodology, population, sampling procedures, and the unit of analysis used.

3.2 RESEARCH SETTING

Data for this study were collected in twenty public secondary schools in the Luvuvhu Circuit of the Vhembe District. The schools were chosen from this district's rural circuit. Questionnaires were distributed among the Grade 11 teachers who were chosen to participate in this study for completion.

3.3 RESEARCH DESIGN

Leedy and Ormrod (2012) point out that quantitative research is based on positivism that enables the adoption of scientific explanations. Quantitative data collection techniques rely on measurements that require the use of verification instruments to objectify the phenomena studied. This study employed the case study design since it helped visit the Luvuvhu Circuit to explore the challenges faced in teaching quadratic functions at the Grade 11 level. This research design was chosen because it enabled me to visit the study area and distribute the questionnaires to the participants. The chosen research design also provided me with the opportunity to observe some of the participants teaching quadratic functions. I also went back to collect the distributed questionnaires when they were completed. In this way, the quantitative research design was advantageous to this study compared to other research designs.

3.4 RESEARCH METHODOLOGY

Miller (2009) sees the research methodology as the creation and development of techniques and strategies for collecting data. In this study, I used the quantitative methodology for its data collection and analysis. This research methodology enabled me to use appropriate research methods, sampling procedures, respondents, and the instruments for collecting and analysing data. This methodology was adopted because it allows for the collection of numerical data. Quantitative research relies on statistics to measure data. Leedy and Ormrod (2007) observed that statistics are simple yet powerful arsenal that can ever be possessed by researchers. That is, researchers employ them when viewing nature and its inherent associates, thereby getting an in-depth understanding of its dynamics. Statistics are thus needed to conceptualise and contextualise incomprehensible phenomena (Leedy & Ormrod, 2007). The information realised through questionnaires was provided in tables. This was done to facilitate its interpretation and understanding, and hence the quantification of the results. That is, the identified theme or category's occurrence frequencies were recorded and enumerated.

3.4.1 Quantitative research methodology

The quantitative methodology is the type of research methodology that uses numbers as its basis for generalising issues around what is studied. Statistics, according to Leedy and Ormrod (2012), are simple but powerful tools in the researcher's hands as they view their nature and interrelationships in an interpretive manner. Quantitative researchers collect data in the form of numbers and use statistical types of data analysis (Terre-Blanche & Durkheim, 1999). This study made use of the survey system, that is, the closed-ended self-designed questionnaire to collect primary data from the informants. This included the implementation of statistics to interpret data.

Using statistics, I was able to conceptualise what otherwise would have been incomprehensible (Leedy & Ormrod, 2012), and hence the advantages of this study. The data gathered through questionnaires were put in frequency tables for easier interpretations. The use of questionnaires enabled this researcher to establish the learners' views concerning their performances in the quadratic functions. A questionnaire is a set of carefully designed questions given to a group of people for the purposes of collecting data about topical issues the researcher is interested in (Jupp, 2006). I gave questionnaires to Grades 10 and 11 learners and educators who took part in this study.

3.4.1.1 The advantages of quantitative research methods

Quantitative research methods' advantages are that they help obtain specific answers to the study questions. Data collected and analysed through this methodology are usually trustworthy due to the questionnaires' uniformity. Another advantage is that the methods are informed by statistically important sample sizes. Their results can be generalised to the entire population as questionnaires can be given to a large sample to respond to. Also, the process does not cost much (Hallway & Jefferson, 2007).

3.5 PRE-TESTING

This is a small version of the actual study that is done to polish up the adopted methodology (Hallway & Jefferson, 2007). Pre-testing helps to identify possible problems in the proposed study and allows the researcher to revise the method and instruments before the study proper is carried out (De Vos, Strydom, Fouche & Deport, 2005). For this study's increased validity, the questionnaires were tested to find out whether they meet this study's expectations (Hallway & Jefferson, 2007). The pre-testing exercise involved 50 participants. The participants were given a questionnaire each. They responded to the questionnaire as requested and the data collected were measured against the research questions. This helped determine the level the informants understood the questionnaire, and hence realigned its questions accordingly. The idea was to determine whether collecting data in this way would yield expected results (Thomas, 2003). The pre-testing also helped me have an insight into my research tools' suitability for the task they were designed to accomplish. The pre-testing group mirrored the actual group in that the former were also Grade 11 Mathematics teachers from the Luvuvhu Circuit Schools.

3.6 POPULATION OF THE STUDY

Bless and Smith (2011) look at the study population in terms of a large set of elements that are of interest to the researcher, and where the study results are to be obtained after testing the samples and generalising the findings. This study's population was made of Mathematics teachers from twenty secondary schools, their HODs, and Principals in the Luvuvhu Circuit.

3.7 SAMPLING PROCEDURE

Creswell (2011) mentioned that a sample that does not represent its population, no matter its size, is not fit for testing reasons. Sampling enables the estimation of the characteristics of the large group through examining those of the smaller groups. A sample is the number of informants identified from the population for data collection (Tavakoli, 2012). This study's sample had school principals, Mathematics HODs, and Mathematics teachers from twenty schools.

Two sampling techniques were adopted in order to come up with this study's sample, vis; cluster and random sampling. These were used to select teachers who were part of this study. Cluster sampling helped classify schools into low, average, and highperforming ones. Each cluster provided six or five schools out of eight, and hence twenty schools were selected here. A simple random sampling technique was adopted for selecting 120 participants for this study. All Grade 11 Mathematics teachers' names in each school were put in the hat. The research assistant held the hat with those names above his head and I then picked six names the hate. The process was

repeated in every cluster until I got the number of the participants I needed. Here, every member of the population had an equal chance to be picked.
Mathematics teachers were randomly picked as long as they taught Grade 11 Mathematics until I had 120 teachers for the study sample.

3.8 DATA COLLECTION PROCEDURE

Leedy and Omrod (2012) stated that data collection is not just a process of collecting data but that of gathering information in unique ways related to the study's purpose. It should be clarified that what literature contains is not all data required for the study. That is, data are facts related to the phenomenon studied.

Regardless of the type of data one uses, the important aspect in research is for one to comprehensibly understand what literature says about their area of study. If properly made and validated, the data collection instruments go a long way in gathering reliable information than they would otherwise have had the tools not been used. Now that we aspire for truthful data representations in the social world, we have to augment our tools with more reliable and valid measuring instruments such as scales and questionnaires (Leedy & Omrod, 2012).

3.8.1 Questionnaire survey

One of the tools used for collecting data here was the questionnaire**.** These were constructed using a set of dimensions and statements that helped explore the challenges teachers face in teaching quadratic functions. The five-point Likert scale ranged from "Strongly Agree" (SA), "Agree" (A), "Neutral" (N), "Disagree" (D) to "Strongly Disagree" (SD). Leedy and Ormrod (2012) noted that the Likert scale is widely used in measuring attitudes. The questionnaire consisted of the close-ended Likert-scale questions, divided into the following dynamics; Mathematics teachers, HODs, and Principals. The respondents were to tick boxes that showed their responses. I administered 120 questionnaires with one consent form each to the identified teachers in the Luvuvhu Circuit. Research assistants were appointed, one from each sampled school to help distribute and collect questionnaires. I had a one day training exercise with them on how to distribute and then collect the questionnaires. Given that they managed to collect the questionnaires they had distributed, I believe they understood what I had instructed them to do.

3.9 DATA ANALYSIS

Bless and Higson-Smith (2014) explained the need for data preparation so as to check and edit the gathered data. Data were organised through numerical codes or numbers for efficiency. The numerical strategy was followed to analyse collected data as it assisted in consistently accounting for, and validating the analysed information. The data were presented the way the informants responded.

This study used the IBM - SPSS version 25 was employed to analyse its data. Data were analysed and presented in frequency tables. This was done immediately after collecting them. Results were interpreted to generate this report. In this case, numerical scores were given to indicate the possible relationships in the participants' responses. Thereafter, frequency lists were constructed. The two outside categories were combined in the analysis. For instance, the researcher combined "strongly agree" and "agree' and also "strongly disagree and disagree" to project a unique response. This allowed for easier discussions and interpretations.

3.10 VALIDITY AND RELIABILITY OF THE STUDY

This section describes this study's validity and reliability issues.

3.10.1 Validity of the study

Validity deals with whether the instruments provide adequate samples of items that represent the concept (De Vos et al., 2005). It refers to the extent to which inferences made based on numerical scores are appropriate, meaningful, and useful to the sample (McMillan & Schumacher, 2001). Validity was ensured by making sure that adequate samples of items were provided. In addition, I made it a point that inferences were made based on numerical scores were appropriate, meaningful, and useful to the study sample.

3.10.2 Reliability of the study

The instrument's reliability refers to the extent to which it consistently measures what it is supposed to measure (Creswell, 2010). Here, the idea is to find out the stability or consistency of the measurement. This is to say that if the same variable is measured under the same conditions, a reliable measurement procedure could bring identical results. It refers to the measuring instrument's ability to yield consistent numerical results each time it is used and it does not fluctuate unless there are variations in the variable being measured (De Vos, 2005).

A test is reliable to the degree that it measures accurately and consistently, yielding comparable results when administered a number of times (Creswell, 2010). To ensure the reliability of the collected data, the questionnaire's contents were verified by an independent individual (colleague) with knowledge about Mathematics teaching. He ascertained the degree to which the said contents met with this study's specifications.

3.11 ETHICAL CONSIDERATIONS

Ethics are moral principles that guide the behaviour expected of a researcher vis-avis his/her study participants and how these are treated during the entire study. Their importance in research cannot be overemphasised. Rubin and Rubin (2008) explained how institutions such as universities are required to have a review board that evaluates the students' and staff members' research proposals. This ensures that all researches are ethically conducted. When permission is granted, researchers begin to recruit participants. This study considered and observed the ethics below.

3.11.1 Informed consent

Here, the informants were issued with an informed consent form to sign. This form contained details about this study's goals and what the informants were required to do during this project. Thus, informed consent is one of the ethics this study took into cognisance. This ethic was considered in that it served as proof that the respondents were not coerced into taking part here. The participants were also informed about the aspect that allowed them to withdraw from the research at any time they so wanted, without being blamed or accused of any misdemeanour over that. All participants agreed to this and signed the consent forms provided.

3.11.2 Confidentiality

This study undertook to respect the participants' wishes in terms of divulging any information that would affect the confidentiality aspect. The participant's information was protected and kept out of reach of anyone not part of this study. In this case, confidentiality was considered an integral part of this study. McMillan and Schumacher (2011) define confidentiality as ensuring that identifying information that could be used to link respondents to their responses is kept private from the public.

In this study, the researcher respected the participants' wishes by not writing their names on their responses. Only pseudonyms were used to refer to them.

3.11.3 Avoidance of harm to participants

The need not to harm the participants in any way imaginable was uppermost during this study. That is, this study avoided harming its informants by revealing the interview contents to them so that they could decide whether they would be harmed if they continued with their participation here. This became the third ethical consideration considered by this study. It involved one being sensitive to the informants during this study, particularly when asking questions and other pertinent issues during an interview session through avoiding asking sensitive questions (Mouton, 2014).

3.11.4 Right to privacy

Leedy and Ormrod (2012) highlight that any study involving human beings should respect their right to privacy. I kept the nature and quality of my participants' responses confidential. I did not report, either oral or in text, in a way that readers would be aware of how my participants responded or behaved.

3.12 LIMITATIONS OF THE STUDY

The possibility of wrongly interpreting questions regarding challenges that face teachers who teach quadratic functions at Grade 11 level in the Luvuvhu Circuit's schools remained a possibility throughout this study. This was high when one considers the collection of data using questionnaires. Using secondary sources was also problematic as these sources' credibility was questionable due to the sources they relied on as well. Due to this topic's sensitivity, certain people felt uncomfortable answering research questions posed to them. Thus, potential threats to this study were observed.

3.13 CONCLUSION

This chapter illustrated the research methodology adopted herein. The population and sampling procedures revealed those who took part here, and how they were picked. Questionnaires helped gather data and this partly led to the completion of this study. I concluded that the population and sampling procedures, as well as research instruments, data collection techniques, and data analysis were more appropriate in this methodology. The chapter that follows presents, interprets, and analyses data as collected from the participants.

CHAPTER 4: DATA PRESENTATION AND ANALYSIS

4.1 INTRODUCTION

This chapter presents results using frequency tables. Results are then analysed in the context of the literature reviewed in chapter two. Data analysis follows themes that are informed by this study's objectives. This is followed by sections and subsections on themes raised during investigations. That is, the second section presents the participants' biographic data and that of the schools' enrolments, and the third section presents data on the respondents' competencies and class teaching strategies. These sections are divided into subsections to help understand the types of data collected in order to answer this study's research questions and achieve its objectives.

4.2 BIOGRAPHIC DATA OF THE RESPONDENTS

The respondents provided their personal information as illustrated in Table 4.1. The information helped me understand what type of respondents were involved in this study. The biographic data analysed here include the respondents' gender, age, and qualifications. Table 4.1 presents results showing the majority (61.6%) of the respondents as males. Females were 38.4% of the respondents.

The results in Table 4.1 also reflect that those who were 51 – 60 years old (33.3%) are in the majority in this circuit, followed by those who were 41 – 50 years old (31.3%). The 31 – 40 age range is 23.2% and the least dominant age range is the 21 – 30, with 21.1%. This means that most Mathematics teachers in the Luvuvhu Circuit are aged between 51 and 60. These are teachers who have a lot of experience in teaching Mathematics if one supposes that they started teaching when they were in their early twenties or thirties.

On the respondents' qualifications, 37.4% had Matric/Grade 12, while those with a first degree were 36.4%. Those with an Honours degree were 26.2%. The results suggest that Mathematics teachers in the Luvuvhu Circuit are qualified to teach Mathematics. That is, they have the basic academic qualifications that are the prerequisite to becoming a professionally qualified teacher. The respondents' professional qualifications data show that 52.5% of them had a professional degree, while 46.5% held diplomas in education. Only 1% of them had a certificate in education. These results suggest that the Luvuvhu Circuit's Mathematics teachers are professionally qualified to teach quadratic functions because they have basic minimum qualifications and some have higher qualifications in Mathematics Education.

Table 4.1: Biographic data.

Attributes	Category	Frequencies	Percentage
Gender	Male	61	61.6
	Female	38	38.4
Age	21 – 30 years	12	12.1
	31 – 40 years	23	23.2
	41 – 50 years	31	31.3
	51 – 60 years	33	33.3
Academic qualifications	Matric/Grade12	37	37.4
	First degree	36	36.4
	Honours	26	26.2
Professional qualifications	Diploma	46	46.5
	Certificate	1	1.0
	Professional degree	52	52.5

4.2.1 Schools enrolments

The national government allocates resources to schools according to the learners' population in each school. Such resources matter a lot when it comes to effective teaching and learning. The school enrolment facilitates the allocation of teachers by the provincial education authorities to each school. Probably, the same applies to teachers who teach quadratic functions in Grade 11. Table 4.2 shows the enrolment range of the respondents' schools.

Table 4.2: Enrolment range.

Enrolment range	Frequency	Percentage
1 – 200 learners	7	7.1
201 – 400 learners	10	10.1
401 – 600 learners	26	26.3
601 – 800 learners	23	23.2
800 + learners	33	33.3
Total	99	100

Schools with 800 learners or more were 33.3%, followed by those with 4001 – 600 learners (26.3%). The schools with the least enrolment (7%) were those whose enrolment ranged from 1 – 200. The results show that most respondents teach in schools with a large population of learners. Schools with a large population (in view of protocols) are provided with more resources when compared to those with the least number of learners. Large classes do not create a conducive environment for teachers to teach effectively, no matter how competent one might be. The next section analyses data regarding this study's first objective.

4.3 THE RESPONDENTS' COMPETENCIES AND CLASS TEACHING STRATEGIES

Teachers inculcate knowledge and skills among learners. They are competent in the use of teaching strategies to help learners understand what they are taught. The respondents' results are presented below.

4.3.1 Competence in teaching quadratic functions to grade 11 learners

Teachers were asked to indicate the extent to which they are competent in the use of teaching strategies in teaching quadratic functions to Grade 11 learners. Generally, teachers who are competent in the use of various teaching strategies often produce good results with their learners. The respondents were asked to respond to this aspect of the questionnaire. Table 4.3 presents results showing how teachers think about their competence in the use of teaching strategies in teaching quadratic functions to Grade 11 learners.

Table 4.3: Teaching quadratic functions to Grade 11 learners.

Response	Frequency	Percentage
Strongly agree	46	46.5
Agree	52	52.5
Neutral	1	2.0
Disagree	0	0
Strongly disagree	0	0

The results show that the majority (52.5%) of the respondents agreed that teachers are competent in teaching quadratic function to Grade 11 learners, 46.5% strongly agreed with the statement, and 2% were not sure of the idea.

The results are in line with Mutambara et al.'s (2020) postulation that teachers who are regarded as competent are those who produce excellent results. Klassen et al. (2021) conclude that competent teachers should be given enough resources to make their work easier, while those deemed to be incompetent should be workshopped to improve their competence. According to Hill et al. (2016), teachers who work hard at school should be acknowledged as such by school authorities.

4.3.2 Appropriate teaching resources that improve teaching strategies

Teachers need teaching resources if they are to teach effectively. Resources also help learners understand concepts that are taught in class. But, not all teachers teach in schools that are able to provide adequate teaching resources to choose from. Table 4.4 presents the respondents' responses concerning choosing appropriate materials that improve their teaching strategies in Mathematics.

Table 4.4: Teaching resources that improve teaching strategies.

Response	Frequency	Percentage
Strongly agree	38	38.4
Agree	56	56.6
Neutral	5	5.1
Disagree	0	0
Strongly disagree	0	0

Table 4.4 shows that the majority (56.6%) of respondents agreed that teachers select appropriate teaching resources that improve their Mathematics teaching strategies, and 38.4% strongly agreed with the statement. Only 5.1% remained neutral. None of the respondents disagreed with the statement. This suggests that teachers select appropriate teaching resources to improve their teaching strategies.

The results are inconsistent with Diaz and Poblete (2018) who state that effective teaching requires the use of appropriate teaching strategies that are complemented by adequate resources. McGarr (2020) admits that resources are an integral part of the teaching and learning process, and teachers should be provided with these if they are to be effective in class. Peel (2020); Mosibudi (2012) observe that schools that lack resources are detrimental to the learners' effective learning. Later, Ozultun and Bukova (2019) found that lessons should be conducted through the use of learning materials. These results suggest that teachers who teach quadratic function at Grade 11 level in the Luvuvhu Circuit select appropriate teaching resources that improve their teaching strategies.

4.3.3 Managing problem solutions by building learners' informal knowledge

Learners come to school with prior knowledge in any subject area. In most cases, what they learn at school are issues they have encountered in their social lives at home or elsewhere. Good teachers are aware of such informal knowledge, and hence should take advantage and capitalise on it as they teach in class. Table 4.5 presents results showing how teachers manage problems by building on the learners' informal knowledge.

Table 4.5: Managing problems by building on learners' informal knowledge.

Response	Frequency	Percentage
Strongly agree	40	40.4
Agree	57	57.6
Neutral	2	2.0
Disagree	0	0
Strongly disagree	0	0

The results presented in Table 4.5 show that the majority (57.6%) agreed that they can manage problem solutions by building on their learners' informal knowledge and 40.4% strongly agreed with this statement. Those who were not sure of the idea were 2%, while none disagreed that they can manage problem solutions by building on their learners' informal knowledge. These results suggest that teachers can manage problem solutions by building on their learners' informal knowledge.

Results are consistent with Bajana (2019) who asserts that teachers should understand that no learner comes to school blank. That is, for any subject matter, teachers should be aware that learners have some background knowledge about it that they informally accrue as they socialise with others at home (Peel, 2020). Makumure (2016) observes that there is informal learning that takes place at home and there is formal learning that happens at school. Mukon (2015) adds that not all information that we have was obtained through formal learning institutions. Mamali (2015) argues that without prior knowledge, it would be difficult for learners to comprehensively grasp what they are formally taught in class. The results suggest that building on their learners' informal knowledge, teachers have quadratic problem-solving teaching skills.

4.3.4 Use of a variety of approaches to teaching Quadratic Function concepts

Mathematics, as is the same with other subjects, requires the use of varied approaches if its concepts are to be effectively taught. Teachers are encouraged to vary the way they teach Mathematics concepts so that all learners are accommodated. It should be noted that learners are comfortable when taught in different methods. There are those approaches that are hard to understand, while others are easy to follow. It is within this context that the respondents were asked for their opinions regarding the use of various approaches to teaching quadratic functions.

Table 4.6 presents results showing that 50.5% of the respondents agreed that they can use a variety of approaches to teaching quadratic function concepts that promote effective learning, and 47.5% strongly agreed with the idea. None of the respondents disagreed, but 2% were not sure of the statement. One can conclude that teachers in the Luvuvhu Circuit can use a variety of approaches to teaching quadratic function concepts that promote learning.

The results are consistent with those of Bekdemir (2010) who observes that teachers who stick to one approach are generally not productive in their teaching. Bajana (2019) points out that the use of different approaches to teaching maximises the learners' chances of mastering the concepts taught. One would also agree that learners have different levels of understanding of what they are taught, and hence the need to use different teaching approaches to accommodate all learners (Bajana, 2019). Sunbul and Gordesli (2021) postulate that subjects such as Mathematics, among others, require innovative and creative teachers if learners are to do well in them. Ruli et al. (2018) reveal that being adaptive in one's teaching approaches is the key to unlocking success in Mathematics as a subject. The results suggest that using a variety of approaches to teaching quadratic function is one of the teachers' quadratic problem-solving teaching skills.

Table 4.6: Various approaches use to teach quadratic functions.

Response	Frequency	Percentage
Strongly agree	47	47.5
Agree	50	50.5
Neutral	2	2.0
Disagree	0	0
Strongly disagree	0	0

4.3.5 Using textbooks quite often during quadratic function lessons

Textbooks have always been an integral part of the teaching and learning process. Teachers use them to refer learners to what is to be done, while learners use them to do their reading or writing exercises. Their shortage, therefore, is calamitous if not outright destructive to the learners' learning endeavors. Thus, there are teachers who always use textbooks in their teaching, and there are those who do not see the need to use them. Table 4.7 presents results to this effect.

Table 4.7: Textbook use in quadratic functions.

Response	Frequency	Percentage
Strongly agree	38	38.4
Agree	49	49.5
Neutral	7	7.1
Disagree	4	4.0
Strongly disagree	1	1.0

Table 4.7 presents results showing the majority of the respondents (49.5%) agreed that they use the textbook quite often during quadratic function lessons, followed by 38.4% who strongly agreed with the statement. Those who disagreed they use textbooks quite often during the quadratic function lessons were 4%, and 1% strongly disagreed they do so. The ones who were not sure of the statement were 7.1%. These results suggest that teachers use textbooks quite often during quadratic function lessons.

The results are in line with Sunbul and Gordesli's (2021) position that textbooks are critical resources in teaching Mathematics in schools. These could be used as reference books or as teachers' guides in cases where instructions are not clear (Schoenfeld, 2008). Bajana (2019) reiterates that schools without textbooks are like banks without money as these cannot service their clients efficiently. Moyana (2016) claims that when textbooks are used more often during the teaching and learning process, learners benefit beyond what we can imagine. Alvior (2014) points out that learners without textbooks find it difficult to read on their own and they always lag behind in most cases. The results suggest that using textbooks quite often during quadratic function lessons shows teachers have quadratic problem-solving teaching skills.

4.3.6 Well-resourced school in the teaching and learning of Quadratic Functions

Mathematics requires adequate resources if it is to be taught effectively. School authorities, notwithstanding the problems bedeviling the education department, should ensure that their schools are well-resourced and equipped if learners are to do well in Mathematics. Teachers in well-resourced schools should also use the resources at their disposal effectively. The table below presents data concerning the level of the schools' resources.

Results presented in Table 4.8 show most respondents (36.4%) agreed that their schools are well-resourced in the teaching and learning of quadratic functions, while 11.1% strongly agreed. Those who disagreed that their schools were well-resourced in the teaching and learning of quadratic function were 32.3%, with 9.1% strongly disagreeing with the statement. The ones who were not sure of the idea were 11.1%. The results suggest that most schools in the Luvuvhu Circuit are well-resourced even though a large number of them are also not well resourced. That is, the results show a small difference (of 4.1%) between the number of well-resourced schools and those that are poorly resourced.

Table 4.8: School resources and the teaching and learning of quadratic functions.

Response	Frequency	Percentage
Strongly agree	11	11.1
Agree	36	36.4
Neutral	11	11.1
Disagree	32	32.3
Strongly disagree	9	9.1

The results are in line with Mamali (2015) who indicates that the Department of Basic Education has tried to provide public schools with sufficient resources despite the problems associated with its budget deficit. Bajana (2019) adds that public schools suffer from the chronicle shortage of basic teaching resources, an issue that has seen the majority of their learners underperforming at the Matric level. On the other hand, Mamali (2015) acknowledges that the issue of resource shortages in public schools goes beyond the obvious as it is linked with the apartheid era. Furthermore, Cerbito (2020) notes that public schools that are well-resourced are a result of good leadership. In contrast, schools that are wasteful have little or no resources at all (Cerbito, 2020). The results indicate that well-resourced schools are likely to positively affect the learners' performance in quadratic functions.

4.3.7 Teachers and adequate training related to curriculum implementation

Curriculum implementation is a preserve of professionally qualified teachers as courses in the teacher-training programmes emphasise it. Thus, properly qualified teachers are well-placed to effectively implement the curriculum in class. The question of teachers being adequately trained to implement the curriculum was asked to participants. Their responses were analysed and are provided in Table 4.9.

Table 4.9: Teachers and adequate training in curriculum implementation.

Response	Frequency	Percentage
Strongly agree	27	27.3
Agree	31	31.3
Neutral	6	6.1
Disagree	26	26.3
Strongly disagree	9	9.1

Table 4.9 presents results showing most respondents (31.3%) agreed that teachers have no adequate training related to curriculum implementation, followed by those who strongly agreed (27.3%). Those who disagreed were 26.3%, and 9.1% strongly disagreed. The neutrals were 6.1%. The results show the majority of teachers are not adequately trained to implement the curriculum in class.

Fares (2018) agrees with these results when he asserts that given the poor Grade 12 results in the majority of public schools, it is obvious that curricula are poorly implemented. Cerbito (2020) asserts that a combination of learner indiscipline and poor teaching in public schools is largely responsible for the performance of learners each year at the national level. Sunbul and Gordesli (2021) state that effective curriculum implementation is a fundamental aspect of the school’s functionality. However, Klassen et al. (2021) argue that curriculum implementation cannot be said to be sorely the teachers’ responsibility, it goes beyond that. In contrast, Ruli et al. (2018) point to the fact that teachers who cannot implement curricula have no business to be in class. The results suggest that teachers' lack of training in curriculum implementation is one of the factors that affect learner performance in quadratic function.

4.3.8 Mathematics teachers have a sufficient understanding of the quadratic functions

For any subject to be effectively taught, teachers should understand it well. A teacher is regarded as an expert in the subject they were trained to teach, and anything to the contrary defeats the purpose for which they are called teachers. In this case, it is expected that Mathematics teachers should be experts in teaching quadratic functions. The following data analysis concerns the Mathematics teachers' expertise in teaching quadratic functions.

Table 4.10: Teachers and understanding of quadratic functions

.

Response	Frequency	Percentage
Strongly agree	26	26.3
Strongly agree	26	26.3
Neutral	4	4.0
Disagree	35	35.3
Strongly disagree	8	8.1

Table 4.10 presents results that show most respondents (35.3%) disagreed with the statement that Mathematics teachers have sufficient quadratic functions understanding to effectively teach them in class. They were followed by those who strongly agreed (26.3%) and those who agreed (26.3%), while 8.1% strongly

disagreed with the statement. Only 8.1% were not sure of the idea. These results confirm that Mathematics teachers have sufficient quadratic function understanding to teach the concept effectively.

The results are consistent with Klassen et al. (2021) who indicate that given that teachers are prepared on how to teach specific subjects during their teacher training courses, it is a foregone conclusion that most if not all can easily fulfill this obligation. Celik and Guzel (2019) postulate that teachers who displayed a lack of understanding of what they teach are those who were allocated subjects they were not trained to teach. But, Ruli et al. (2018) found that there are teachers who are generally incompetent such that one cannot understand how they became teachers in the first place. Samanian and Roohani (2018) add that competent teachers are those with sufficient knowledge of the subject they teach. On the other hand, Lubienski and Mewborn (2011) point out that teaching is a calling to most teachers, while only a few misfits are found within the teaching profession. The results suggest that teachers' ability to implement the curriculum affects learner performance in the quadratic function.

4.3.9 Teacher attitude towards quadratic functions contributes to learners' performance

Teachers are supposed to be exemplary in class so that learners emulate them. If they exhibit a good attitude towards the teaching and learning process, so would their learners. But, if they have a negative attitude towards lessons and learning in general, it becomes difficult for them to convince learners to be positive. That is why the teachers' attitude in class and at school should always be positive as it has a direct effect on the learners' performance in class. The results are presented in Table 4.11.

The results presented in Table 4.11 show that 59.6% of the respondents strongly agreed that the teachers' attitude towards quadratic functions contributes to learners' performance, and 29.3% agreed with this statement. However, 4% disagreed that the teachers' attitude towards quadratic functions contributes to the learners' performance, and 7.1% were not sure of it. These results show the teachers understand that their attitude has a profound impact on the learners' performance in quadratic functions.

Table 4.11: Teachers' attitude towards quadratic functions.

Response	Frequency	Percentage
Strongly agree	59	59.6
Agree	29	29.3
Neutral	7	7.1
Disagree	4	4.0
Strongly disagree	0	0

The results are consistent with Adler and Pillay's (2017) findings that teachers who were found to be enthusiastic in their work were those whose classes performed well at school. Adler and Pillay (2017) note that the teacher's attitude is commensurate with the learners' progress at school. Similarly, academic excellence was seen as a product of dedicated teachers who instill a sense of hard work and discipline in their learners (Celik & Guzel, 2019). Ozaltun and Bukova (2019) add that highly performing classes are emblematic of their teachers' positive attitude towards the teaching and learning process. However, Makumure (2016) decries the "I do not care attitude" that is displayed by some teachers in public schools as such attitude is detrimental to the learners' academic achievement. The results suggest that the teachers' attitude towards quadratic functions is one of the factors that affect learner performance in Mathematics.

4.3.10 Learners are given more time on tasks to master quadratic function skills

Quadratic function skills cannot be understood if learners are not given enough time to practice given tasks. Learners need to practice as many quadratic function tasks as possible if they are to master skills relevant to the concept. Also, learners tend to work at their own pace, given that they have different levels of understanding of what they are taught. Table 4.12 presents the results concerning this statement.

Table 4.12: Giving learners more time on quadratic function tasks.

Response	Frequency	Percentage
Strongly agree	41	41.4
Agree	45	45.4
Neutral	8	8.1
Strongly disagree	0	0
Disagree	5	5.1

Table 4.12 presents results showing the majority (45.4%) of the respondents agreed they give learners more time on tasks to master quadratic function skills, and 41.4% of respondents strongly agreed with this statement. However, 5.1% disagreed they give learners more time on tasks to master quadratic function skills. Only 8.1% were not sure of the idea. The results confirm that Mathematics teachers give learners more time on tasks to master quadratic function skills.

The results are in line with Ozaltun and Bukova (2019) who suggest that learners, due to their different levels of comprehension, should be afforded the opportunity to do their work without interruptions. Lavigne (2018) notes that learners who are not given enough time to practice what they learn in class on their own generally perform poorly.

Mutambara et al. (2020) state that teachers can help learners acquire certain skills if they allow them to work on their own, particularly on problems that require more practice. According to Esquer et al. (2017), teachers who fail to afford learners enough time to do their work are guilty of ineffective teaching. Ozaltun and Bukova (2019); Samanian and Roohani (2018) add that teachers are encouraged to give as much time to learners to do their work as they possibly can. The results suggest that teachers who give their learners enough time to do quadratic function tasks positively affect learner performance in Mathematics.

4.3.11 Learning environment is conducive to learning Mathematics

Learners should be taught in an environment that supports their learning. That is, teachers should create a learning environment that encourages learners to participate in the teaching and learning process without hindrance. Learners should enjoy learning Mathematics as much as teachers enjoy teaching the subject. This means that the learning environment should be favourable to learners. Table 4.13 presents results in the context of this statement.

Table 4.13: Conducive learning environment in Mathematics.

Response	Frequency	Percentage
Strongly agree	13	13.1
Agree	39	39.4
Neutral	7	7.1
Disagree	34	34.3
Strongly disagree	6	6.1

Table 4.13 presents results that show 39.4% of the respondents agreed the learning environment in their schools is conducive to learning Mathematics, while 13.1% strongly agreed with the statement. However, 34.3% disagreed that their schools' learning environment is conducive to learning Mathematics, and 6.1% strongly disagreed with this statement. Only 7.1% were not sure of the idea. The results suggest that schools have a conducive environment for learning Mathematics.
The results are consistent with Kennedy's (2019); Beilock et al's. (2017) position that schools should create an enabling environment to learn Mathematics if their results in the subject are to improve. Kahan et al. (2013) observe that schools that do well in Mathematics are those whose learning environment is conducive to learners. As stated by Esquer et al. (2017), Mathematics teaching can only be effective when learners enjoy what they are taught at school. If learners are taught under difficult conditions and circumstances, they are likely to not concentrate, thus making it hard for them to understand what they are taught (NCTM, 2020). Kennedy (2019) states that the most important aspect in understanding what is taught in class is for learners to enjoy their learning. Results indicate that an enabling school environment helps learners perform well in Mathematics' quadratic functions.

4.3.12 Class size contributes to the learners' performance in Mathematics

In general, most public schools have large classes due to the fact that education is free there. This is in contrast to private schools where classes are relatively small given that learners pay for their education in such schools. That is, only privileged learners do their schooling in private institutions. Given the large numbers of learners who attend public schools, it is possible for one to assume that large classes contribute to the learners' performances in those institutions. Table 4.14 presents results to this effect.

In Table 4.14, presented results show the majority of respondents (55.5%) strongly agreed that class size contributes to the learners' performance in Mathematics, and 27.3% agreed with this statement. In contrast, 11.1% disagreed that class size contributes to the learners' performance in Mathematics, while 1% strongly agreed with this statement. Only 5.1% were not sure of the idea. The results suggest that class size contributes to how learners perform in Mathematics.

Table 4.14: Class size and the learners' performance in Mathematics.

Response	Frequency	Percentage
Strongly agree	55	55.5
Agree	27	27.3
Neutral	5	5.1
Disagree	11	11.1
Strongly disagree	1	1.0
Total	99	100

The results are in line with Cerbito's (2020) observations that large classes tend to have negative consequences to effective teaching and learning, while small ones are ideal for effective teaching and learning. Cerbito (2020) acknowledges that when learners are taught in large and overcrowded classes, their school performance deteriorates. Basically, class size determines the teacher's effectiveness in as much as it affects the learners' performance at school (Esquer et al., 2017). Cerbito (2020) adds that teaching too many learners makes teachers lose their appetite for teaching, and thus directly affects the learners' academic performance. Sunbul and Gordesli (2021) point out that class size has a direct bearing on how learners perform at school. The results indicate that large classes are part of the factors that affect learner performance in Mathematics' quadratic functions.

4.3.13 Schools are well resourced in teaching and learning of quadratic function

Well-resourced schools, by their very nature of having enough resources at their disposal, provide an enabling environment for teaching and learning Mathematics, particularly its quadratic functions concept. In this regard, one would expect that schools in the Luvuvhu Circuit are well-resourced for teaching and learning quadratic functions given that less-resourced schools usually produce poor results at the national level. Questioned on this aspect, respondents provided responses reflected below. Table 4.15 presents results that show the majority of respondents (37.4%) agreed their schools are well-resourced in teaching and learning quadratic functions, and 15.1% strongly agreed with the idea. Conversely, 31.3% of respondents disagreed their schools are well-resourced in teaching and learning quadratic function, while 6.1% strongly disagreed with that. Those who had no idea of what to say were 10.1%. The results suggest that schools are well-resourced in teaching and learning quadratic functions.

The results are consistent with Beilock et al's (2017) findings that in general, government schools are well-resourced in teaching and learning Mathematics given that they are supplied with various equipment to that effect. Sunbul and Gordesli (2021) assert that most government schools have sufficient resources for effective teaching and learning process. Ruli et al. (2018) add that schools that are poorly resourced produce poor results at the end of the year given that learners struggle to access important learning materials such as mathematical sets, textbooks, and computers, inter alia.

Table 4.15: School resources and learning quadratic functions.

Response	Frequency	Percentage
Strongly agreed	15	15.1
Agreed	37	37.4
Neutral	10	10.1
Disagreed	31	31.3
Strongly disagreed	6	6.1
Total	99	100

Diaz and Poblete (2018) explain that well-resourced schools are perfect examples of how to prepare learners for their national examinations. Sunbul and Gordesli (2021); Mosibudi (2012) argue that not all schools are privileged to have adequate resources to effectively teach learners in class. The results indicate that well-resourced schools positively affect learner performance in Mathematics' quadratic functions.

4.3.14 Curriculum changes affect learners' performance in quadratic functions

Schools enroll learners from different cultural backgrounds. Once learners meet in class, they converge under one curriculum. As a result, the curriculum tends to bring them together through the process of teaching and learning. This affects the learners' performance in quadratic functions. Curriculum changes, in most cases, are due to different policies implemented by the government. As a result, the way learners learn in class is dependent on the new curriculum adopted by the DBE.
Statement 4.2.14 results are presented in Table 4.16.

Table 4.16: Curriculum changes in quadratic functions.

Response	Frequency	Percentage
Strongly agree	46	46.5
Agree	29	29.3
Neutral	11	11.1
Disagree	11	11.1
Strongly disagree	2	2.0
Total	99	100

Table 4.16 presents results showing 46.5% of the respondents strongly agreed curriculum changes affect the learners' performance in quadratic functions, while 29.3% agreed with the statement. However, 11.1% disagreed that curriculum changes affect the learners' performance in quadratic functions, and 2% strongly disagreed. Only 11.1% were not sure of the idea. The results indicate that the learners' performance in quadratic functions is affected by curriculum changes.

The results are in line with Kennedy's (2019) observation that curriculum change brings about change in the way learners learn, act, and reason, particularly so with high school learners. Ozaltun and Bukova (2019) agree as well, pointing out that when children go to school, they do so guided by the new curriculum changes. But, once they start learning new curriculum content, learners' behaviour changes, thereby affecting their school performance. Christie and Morris (2019) found that learners who are affected by curriculum changes are those who attend poor public schools that cannot obtain equipment relevant to the new curriculum. Flockton and Cunningham (2020) state that curriculum change tends to confuse learners, and this makes them lose concentration in class. Additionally, Sorensen (2021); Depaepe, Verschaffel, and Kelchtermans (2013) indicate that curriculum change plays an important role in the way learners perform at school, thus it affects the learners’ performance in one way or the other. The results suggest that curriculum change is among the factors that affect the learners’ performance in Mathematics, particularly in quadratic functions.

4.3.15 Culture contributes to learner performance in quadratic functions

Culture is one of the contributory factors in the learner performance in all facets of learning. Culture reflects a people’s way of life, behaviour, and learning. In the case of schools, culture helps learners learn in class, thereby enhancing their academic performance. The results concerning this statement are presented in Table 4.17.

The results presented in Table 4.17 show 40.4% of respondents strongly agreed that culture contributes to learner performance in quadratic functions, while 30.3% agreed with the idea. In contrast, 12.1% of respondents disagreed culture contributes to learner performance in quadratic functions, and 6.1% strongly disagreed. Those who were not sure of the idea were 11.1%. The results indicate that culture contributes to learner performance in quadratic functions.

Table 4.17: Culture and learner performance in quadratic functions.

Response	Frequency	Percentage
Strongly agree	40	40.4
Agree	30	30.3
Neutral	11	11.1
Disagree	12	12.1
Strongly disagree	6	6.1
Total	99	100

The results reflective Ozaltun and Bukova's (2019) understanding that culture plays an important role in our children's learning at school. Ball et al. (2008) are of the view that culture impact our understanding of what we are taught at school, what we learn, and how we learn. Choi (2019); Ozaltun and Bukova (2019) demonstrate how culture contributes to the learners' performance as children learn from what they already know. Celik and Guzel (2019) argue that without culture, our learning would be baseless given that we are culturally defined, identified, and associated. The results suggest that culture is part of the factors that affect learner performance in Mathematics' quadratic functions.

4.3.16 Learners' foundation in primary school Mathematics affects their performance

Primary education plays an important role in our children's education at high school. That is, primary education lays the foundation for learners at high school. Without a primary school foundation, it would be difficult for learners to understand Mathematics at high school. Primary school Mathematics provides the basics for understanding high school Mathematics. In Table 4.18, results concerning this statement are presented. Table 4.18 presents results that show the majority of respondents (64.6%) strongly agreed that the learners' foundation in primary school Mathematics affects their performance, and 28.3% agreed. However, 2% of the respondents disagreed that the learners' foundation in primary school Mathematics affects their performance. Only 5.1% were not sure of the idea. The results indicate that the learners' foundation in primary school Mathematics affects their Mathematics performance at secondary school.

Table 4.18: Learner foundation in primary school Mathematics.

Response	Frequency	Percentage
Strongly agree	64	64.6
Agree	28	28.3
Neutral	5	5.1
Disagree	2	2.0
Strongly disagree	0	0
Total	99	100

The results are in line with Peel (2020); Ball et al. (2011) who pointed out that learners should have a strong elementary foundation if they are to succeed with their education at the secondary school level. Celik and Guzel (2019) are of the view that having a solid mathematical background is one of the prerequisites for obtaining good Mathematics results at high school. Ruli et al. (2018) observe that once learners fail to grasp Mathematics at the primary school level, it would be quite impossible for them to succeed in the subject at higher levels. Bajana (2019) bemoans the fact that learners who fail to take their primary school work seriously are likely to perform dismally at the secondary school level. Peel (2020); Good and Lavigne (2018) express their wish for learners to be effectively taught at the primary school level as it is the bedrock for future academic success. The results suggest that the learners' strong Mathematics foundation at primary school affects their performance in that subject at the secondary school level.

4.3.17 Media make teaching and learning of quadratic functions easier

Teaching and learning media are very important in enhancing the learners' understanding of any subject taught. Teachers worth their profession always use such media when delivering lessons in class. The use of teaching and learning media enables learners to deal with concepts practically while assisting the teacher to clarify abstract concepts. Thus, media help blend theory and practice. In this regard, their importance in the teaching and learning process cannot be overemphasised. Table 4.19 presents results concerning this idea.

In Table 4.19, presented results show that most respondents (51.5%) agreed media make teaching and learning quadratic functions easier, while 42.4% strongly agreed with the statement. Only 2% disagreed that media make teaching and learning quadratic functions easier. Those who were not sure of the idea were 4.1%. The results suggest that media make teaching and learning of quadratic functions easier.

The results are consistent with Kutama (2012) who observes that the use of media in teaching is key to the learners' understanding of concepts taught as they relate these with the objects being used. Good and Lavigne (2018) assert that teaching and learning media such as campus and pencils enable learners to draw, measure, and calculate angles as instructed by teachers. Opper (2019) believes that learners who are taught without the use of the teaching and learning media generally perform poorly in examinations compared to those taught through the use of such media. Flockton and Cunningham (2020); Good and Lavigne (2018) argue that media plays an important role in the teaching and learning of concepts in class, given that learners are made to practice what they are taught. Beilock et al. (2017) add that most public schools that struggle to obtain teaching and learning materials have lower pass rates than those with enough media. The results indicate that media use in teaching and learning affects learner performance in Mathematics, especially in its quadratic functions aspect.

Table 4.19: Media and the teaching and learning of quadratic functions.

Response	Frequency	Percentage
Strongly agree	42	42.4
Agree	51	51.5
Neutral	4	4.1
Disagree	2	2.0
Strongly disagree	0	0
Total	99	100

4.3.18 Attitude contributes to quadratic functions performance

Attitude defines how we perform at school or any activity for that matter. That is, if one has a bad attitude towards Mathematics, that individual is most likely to perform poorly in the subject. But, if one's attitude towards Mathematics is positive and accommodative to the teacher's instructions, then one is likely to pass the subject with excellent symbols. The respondents' results are presented in Table 4.20.

The results presented in Table 4.20 show that most respondents (64.6%) strongly agreed that attitude contributes to quadratic functions performance, and 21.2%

agreed. Conversely, 5.1% of the respondents disagreed that attitude contributes to quadratic functions performance, while 4% strongly disagreed with this statement. Those who were not sure of the idea were 5.1%.

Table 4.20: Attitude and quadratic functions performance.

Response	Frequency	Percentage
Strongly agree	64	64.6
Agree	21	21.2
Neutral	5	5.1
Disagree	5	5.1
Strongly disagree	4	4.0
Total	99	100

The results are in line with Cerbito's (2020) findings that learners with a positive attitude to school work excel in class than those with a negative attitude. Kerans (2014) discovered that learners who come to school with a bad attitude towards Mathematics experience most difficulties in the subject. Moyana (2016) identifies attitude as one of the causes of learner failures in Mathematics, particularly in public schools. Cerbito (2020) reveals that high-scoring learners in Mathematics are those who are fond of the subject and always exhibit their intentions to do well by studying hard. Flockton and Cunningham (2020) agree that a good attitude in Mathematics means such learners are likely to perform better than those with a bad attitude. The results indicate that attitude affects learner performance in quadratic function.

4.3.19 Boys perform better than girls in quadratic functions

Naturally, the learners' performance in any subject cannot be measured in terms of gender. That is, it is unrealistic for one to generalise that boys perform better in Mathematics than girls, or vice-versa. Only through scientific studies can this debate be determined. It is within this context that this study sought to understand the respondents' views regarding this issue. The results of their responses are presented in Table 4.21.

Table 4.21: Boys and girls in quadratic functions learning.

Response	Frequency	Percentage
Strongly agree	9	9.1
Agree	11	11.1
Neutral	15	15.1
Disagree	27	27.3
Strongly disagree	37	37.4
Total	99	100

Table 4.21 presents results that show the majority of the respondents (37.4%) strongly disagreed that boys perform better than girls in quadratic functions, and 27.3% disagreed with the statement. Those who agreed with the statement were 11.1%, and those who strongly agreed were 9.1%. A significant percentage of 15.1 was not sure of the idea. The results suggest that teachers do not believe that boys perform better than girls in quadratic functions.

The results are in line with Makumure (2016) who notes that there is no truth in the supposition that boys perform better in Mathematics than girls. In support of this statement, Flockton and Cunningham (2020); Meyer and Kloehler (2009) point out that under normal circumstances, it is not realistic to assume that boys outperform girls in Mathematics. Cerbito (2020) alludes to the fact that learners, be it boys or girls, can do extremely well in any subject provided they are taught well and have the zeal to excel. Ozaltun and Bukova (2019) acknowledge the dangers that come when we falsely believe that there is a gender that can perform better than another gender at school. In view of the unsubstantiated claims that boys are better than girls in Mathematics, Cerbito (2020) claims that the learners' performance in any subject at school has nothing to do with their gender. The results indicate that the issue of ascribing gender in generalising the learners' performance in Mathematics is one of the challenges teachers face in teaching quadratic functions.

4.3.20 Peer pressure affects quadratic functions

Peer pressure is one of the characteristics of group dynamics that shape the learners' behaviour at school and in class. It can do so either for the good or bad. Learners who are under peer pressure more often than not tend to be radical in behaviour, irresponsible, wayward or delinquents. These tendencies affect their performance in class and hence poor results due to endless disciplinary issues at school. The respondents' results on this issue are presented in Table 4.22.

Table 4.22: Peer pressure and quadratic functions learning.

Response	Frequency	Performance
Strongly agree	52	52.5
Agree	28	28.3
Neutral	6	6.1
Disagree	11	11.1
Strongly disagree	2	2.0
Total	99	100

Table 4.22 presents results that show the majority of respondents (52.5%) strongly agreed that peer pressure affects quadratic functions, and 28.3% agreed with the statement. However, 11.1% of the respondents disagreed that peer pressure affects quadratic functions, with 2% strongly disagreeing. Only 6.1% were not sure of the statement. Results indicate that teachers agree that peer pressure affects quadratic functions.

The results are in line with McGarr (2020); Sorensen's (2013) observations that peer pressure has adverse effects on learners who bow to it. McGarr (2020) opines that if left uncontrolled, peer pressure is likely to affect the learners' performance at school.

Christie and Morris (2019) admit that those who succumb to peer pressure usually find themselves on the wrong side of the law, and hence spend most of their school time attending to disciplinary issues. Esquer et al. (2017) claim that there are many ways in which peer pressure affects the learners' performance at school. Ozaltun and Bukova (2019) indicate that peer pressure has several ramifications for learners, some of which are poor performances at school. The results suggest that peer pressure is regarded as one of the factors that affect quadratic functions teaching.

4.3.21 Interest in quadratic functions improves learners' performance in them

When one does whatever he does with interest, chances are he is likely to succeed. The same goes for learners who have an interest in quadratic functions. Learners interested in quadratic functions are likely to do their work wholeheartedly and hence perform well. The results from the respondents' responses are presented in Table 4.23.

Table 4.23: Quadratic functions interest and learner performance.

Response	Frequency	Percentage
Strongly agree	62	62.6
Agree	35	35.4
Neutral	2	2.0
Disagree	0	0
Strongly disagree	0	0
Total	99	100

The results presented in Table 4.23 show that the majority of respondents (62.6%) strongly agreed that interest in quadratic functions improves the learners' performance in the concept, while 35.4% agreed with the statement. None of the respondents either disagreed or strongly disagreed. Only 2% were not sure of the idea. The results suggest that teachers agree that interest in quadratic functions improves the learners' general performance in Mathematics.

The results are consistent with Ruli et al.'s (2018) observations regarding the power of interest in aiding learners to improve their performance at school. Ozaltun and Bukova (2019) discovered that learners who show interest in learning perform better in class compared to those who are disinterested. Christie and Morris (2019) explains that as a supposedly difficult subject, Mathematics is performed well by those who like it, while those who do not like it lag behind in class. Ozaltun and Bukova (2019) explain that those who like Mathematics are seen by their good marks at the end of each term, and those who do not like it fail the subject. Ozaltun and Bukova (2019) reveal that doing well in any subject hinges on one's interest in it. The results indicate that learners can only improve their quadratic functions performance only if they show interest in learning the concept.

4.3.22 I enjoy teaching and learning of quadratic functions

The teaching and learning process should be enjoyed by those involved in it. That is, teachers should enjoy teaching, while learners should enjoy learning what they are taught. Many teachers, one would assume, teach because they enjoy teaching. For those who did so due to desperation, miserable life at work is what they experience. The results of the respondents' responses are presented in Table 4.24.

Table 4.24 presents results that show 51.5% of the respondents agreed they enjoy teaching and learning quadratic functions, and 41.4% strongly agreed with the statement. However, only 1% of the respondents disagreed they enjoy teaching and learning quadratic functions. Only 6.1% were not sure of the statement. The results show that teachers enjoy the teaching and learning of quadratic functions.

Table 4.24: Teaching and learning quadratic functions.

Response	Frequency	Percentage
Strongly agree	41	41.4
Agree	51	51.5
Neutral	6	6.1
Disagree	1	1.0
Strongly disagree	0	0
Total	99	100

The results are in line with Diaz and Poblete's (2018) position that in the majority of cases, teachers enjoy teaching. Christie and Morris (2019) admit that only a few teachers do not take joy in the teaching and learning process. However, Fares (2018) warned that it should not be taken for granted that all those who join the teaching profession do so out of love for it. Sorensen (2021) adds that there are those who became teachers by default, and these are usually seen by their negative attitude when undertaking the teaching and learning process. Fares (2018) concludes that in as much as there are those who do not enjoy teaching quadratic functions, we should appreciate that most Mathematics teachers enjoy teaching the concept. The results indicate that teachers generally like teaching Mathematics, and this positively affects the learners' performance in the subject.

4.3.23 Teaching of quadratic functions contributes to learners' performance

Learners generally perform well when they are effectively taught. As such, there is no doubt that the teaching of quadratic functions contributes to their performance at school. The respondents' results in response to statement 4.2.23 are presented in Table 4.25.

The results presented in Table 4.25 show that the majority of respondents (56.6%) strongly agreed that the teaching of quadratic functions contributes to the learners' performance, and 30.3% agreed with the statement. However, 4% strongly disagreed that the teaching of quadratic functions contributes to the learners' performance, while 3% disagreed. Only 6.1% of the respondents were not sure of the idea. The results indicate that teachers are agreed that the teaching of quadratic functions contributes to the learners' performance in Mathematics.

Table 4.25: Teaching of quadratic functions and learner performance.

Response	Frequency	Percentage
Strongly agree	56	56.6
Agree	30	30.3
Neutral	6	6.1
Disagree	3	3.0
Strongly disagree	4	4.0
Total	99	100

The results are in line with Moyana's (2016) observation that teaching, in general, helps one understand certain issues he/she would not have been aware of, and hence it improves our knowledge. Mutambara et al. (2020) assert that teaching quadratic functions is important in helping learners improve their performance in Mathematics. Fares (2018) reveals that learners who are taught quadratic functions are likely to master the concept, leading to their improvement in the subject. Sunbul and Gordesli (2021) point out that the teaching of any concept is vital for the improvement of the learners' performance. The results suggest that only through teaching concepts such as quadratic functions can the learners' performance in Mathematics be positively affected.

4.3.24 Memorisation helps in teaching and learning of quadratic functions

Rot learning is considered a bad teaching and learning strategy as it makes learners easily forget what they were made to memorise. But, there are teachers who prefer using this strategy despite its widely noted disadvantages. In fact, memorisation does not lead to the mastery of concepts taught but requires that learners retain what they were taught for a short time only. The respondents' results in this regard are presented in Table 4.26.

The results presented in Table 4.26 show that the majority of respondents (41.4%) agreed that memorisation helps in the teaching and learning of quadratic functions, and 29.3% strongly agreed with the idea. In contrast, 12.1% of the respondents disagreed that memorisation helps in the teaching and learning of quadratic functions, and 7.1% strongly disagreed. The ones who expressed uncertainty with the statement were 10.1%. The results suggest that teachers favour the use of the memorisation strategy as they believe that it helps in the teaching and learning of quadratic functions.

The results are in line with Peel (2020); Mukono (2015) who indicate that at times memorisation of concepts taught goes a long way in improving the learners' understanding of what they learned in class. Klassen et al. (2021); Depaepe et al. (2015) found that when learners memorise what they are taught, they are likely to comprehend difficult concepts in Mathematics. Sunbul and Gordesli (2021); Zakaria (2010) outline the need to encourage learners to memorise what teachers teach in class to improve their understanding of quadratic functions. Hill et al. (2016) illustrate that the teaching of quadratic functions could be improved by helping learners memorise what they learn. In addition, Good and Lavigne (2018) decry the teachers' lack of learner motivation when it comes to making learners memorise concepts. The results indicate that teachers are at liberty to use the memorisation strategy in teaching quadratic functions as it is part of the factors that affect the learners' performance in Mathematics.

Table 4.26: Memorisation in teaching and learning quadratic functions.

Response	Frequency	Percentage
Strongly agree	29	29.3
Agree	41	41.4
Neutral	10	10.1
Disagree	12	12.1
Strongly disagree	7	7.1
Total	99	100

4.3.25 Psychological impact of quadratic function contributes to learner performance

There are topics in Mathematics that when mentioned have a psychological impact on learners. One of these topics is quadratic functions. There are learners who believe that this topic is difficult to learn, and because of such belief, they intimidate others into thinking in the same way. Table 4.27 presents the results of the respondents' responses concerning this statement.

Table 4.27 presents results that show the majority of respondents (52.5%) agreed that the quadratic functions' psychological impact contributes to learner performance, and 26.3% strongly agreed. However, 6.1% of the respondents disagreed that the quadratic functions' psychological impact contributes to learner performance, while 2% strongly disagreed. The results suggest that quadratic functions have a psychological impact that contributes to learner performance.

The results are in line with Good and Lavigne's (2018) position that the mere mention of certain topics or subjects sends shivers down the learners' spines. Peel (2020) posits that most learners become scared when the topic quadratic functions is mentioned as they believe that it is one of the most difficult topics in Mathematics, thereby affecting their performance. McGarr (2020); Kerans (2014) decry the fact that some learners fail to reach their potential in Mathematics as they are psychologically damaged by those who exaggerate the subject's level of difficulty.

Table 4.27: Quadratic functions' psychological impact to learner performance.

Response	Frequency	Percentage
Strongly agree	26	26.3
Agree	52	52.5
Neutral	13	13.1
Disagree	6	6.1
Strongly disagree	2	2.0
Total	99	100

Meanwhile, Moyana (2016) reasons that whether a topic is difficult or not, learners must not be misled by those who seek to portray certain subjects as undoable. Sunbul and Gordesli (2021) illustrate that the level of difficulty of each Mathematics topic is dependent on the learners' psychological preparedness to do it. The results suggest that teachers are aware of the psychological impact quadratic functions have on learner performance as it affects their general performance in Mathematics.

4.3.26 Learners do solve quadratic function problems at home as there is someone to guide them

Homework is an important aspect of the child's schoolwork. But, if learners are to meaningfully do their homework, there should be someone at home to assist them with that. It is important, therefore, that learners solve quadratic function problems correctly under the guidance of their parents or relatives at home as part of their homework. The respondents' response results are presented in Table 4.28.

Table 4.28: Learners solving quadratic function problems at home.

Response	Frequency	Percentage
Strongly agree	11	11.1
Agree	38	38.4
Neutral	12	12.1
Disagree	33	33.3
Strongly disagree	5	5.1
Total	99	100

Table 4.28 presents results that show the majority of respondents (38.4%) agreed learners solve quadratic functions at home as there is someone to guide them, and 11.1% strongly agreed with the statement. In contrast, 33.3% of the respondents disagreed that learners solve quadratic function problems at home as there is someone to guide them, while 5.1% strongly disagreed. Only 12.1% of respondents were not sure of this statement. The results indicate that learners have someone who assists them with quadratic functions homework at home.

The results are in line with Goog and Lavigne (2018) who illustrate that learners do solve quadratic function problems at home as there is someone to guide them. Sunbul and Gordesli (2021) found that most learners do their homework at home assisted by either their parents or relatives. However, Maree (2011) argues that it has become common practice for parents to literally do their children's homework instead of assisting them as should be the case. Beilock et al. (2017) add that when parents help their children do quadratic functions homework at home, they should take into cognisance the fact that it is wrong for them to write it as opposed to guiding them. Flockton and Cunningham (2020) observe that learners who are assisted with their homework usually perform better in quadratic functions than those who are not. The results indicate that parents or guardians help their children with quadratic functions homework, a factor that affects the learners' performance at school.

4.3.27 Learners have Mathematical instruments to draw in a quadratic functions

Quadratic functions concept includes drawings. Learners can only do so when they have Mathematical instruments suitable for specific drawings. It is difficult to teach quadratic functions to learners who do not have Mathematics instruments to draw when they are required to do so. The respondents' results are presented in Table 4.29.

Table 4.29: Learners and Mathematical instruments in quadratic functions learning.

Response	Frequency	Percentage
Strongly agree	12	12.1
Agree	35	35.4
Neutral	4	4.0
Disagree	31	31.3
Strongly disagree	17	17.2
Total	99	100

Table 4.29 presents results that show 35.4% of respondents agreed learners have mathematical instruments to draw in quadratic function lessons, and 12.1% strongly agreed with the statement. However, 31.3% of respondents disagreed learners have mathematical instruments to draw in quadratic functions, while 17.2% strongly disagreed. Only 4% of respondents were not sure of the idea. The results suggest that most learners do not draw in quadratic function lessons as they do not have mathematical instrument sets.

The results are consistent with Cerbito (2020) who asserts that almost half of the learners come to school unprepared for learning Mathematics as they do not have mathematical instruments to draw when required to. Ozaltun and Bukova (2019) admit that some learners have difficulties in obtaining mathematical instruments needed for quadratic function lessons. Flockton and Cunningham (2020) point out that one way in which learners can understand quadratic functions is for them to be able to draw during lessons. Cerbito (2020) opines that learners who do not have mathematical instruments to draw during quadratic function lessons lose out as they do not participate in such activities. Mosibudi (2012) said that the learners' failure to have mathematical instruments is a setback to their understanding of quadratic functions. The results indicate that the learners' failure to have mathematical instrument sets negatively affects their performance in quadratic functions as they fail to draw diagrams as required.

4.3.28 Television use in teaching Mathematics affects learner performance

The use of advanced teaching and learning media such as television sets is largely a preserve of rich schools. However, public schools in rural areas have pooled resources together to establish central resource centres where such media can be accessed. Their use, nonetheless, is said to affect the learners' performance in Mathematics. The results of the respondents' responses in this context are presented in Table 4.30.

In Table 4.30, the presented results show the majority of respondents (48.4%) agreed the use of television sets in teaching Mathematics affects the learners' performance, and 29.3% strongly agreed with this sentiment. In contrast, 7.1% of the respondents strongly disagreed that using television when teaching Mathematics affects the learners' performance, and 6.1% disagreed with this point. Only 9.1% of respondents were not sure of the statement. The results suggest that teachers agree using television sets when teaching Mathematics affects the learners' performance.

The results are in line with Peel (2020); Johns' (2015) position that when teachers use television sets as media in teaching Mathematics, the learners' performance is affected. Ozaltun (2019) states that using media such as television sets in teaching Mathematics enhances the learners' understanding of concepts taught.

Table 4.30: Television use in teaching Mathematics.

Response	Frequency	Percentage
Strongly agree	29	29.3
Agree	48	48.4
Neutral	9	9.1
Disagree	6	6.1
Strongly disagree	7	7.1
Total	99	100

Jones (2012) proves that learners who are exposed to technical media use such as television in their learning perform better than those who are not exposed to them. Peel (2020) claims that not all schools enjoy the privilege of having access to stateof-the-art media such as television sets, computers, overhead projectors, and tablets, among others. Ozaltun and Bukova (2019) postulate that modern educational trends call for the use of technical media in teaching and learning subjects such as Mathematics. The results indicate that teachers are aware that the use of television sets is one of the factors that affect learner performance in quadratic functions.

4.3.29 Weekend/winter schooling affect learner performance in a quadratic function

Learners who attend weekend or winter school cover more ground in their learning than those who do not. Extra schooling enables teachers and learners to revisit what they did not cover during the term, thereby attending to the areas that were skipped. This is important in that it helps learners improve their performance in quadratic functions.

Table 4.31: Weekend/winter schooling and learner performance in quadratic functions.

Response	Frequency	Percentage
Strongly agree	35	35.4
Agree	46	46.5
Neutral	6	6.0
Disagree	7	7.1
Strongly disagree	5	5.0
Total	99	100

Table 4.31 presents results showing 46.5% of the respondents agreed weekend/winter school affects the learners' performance in quadratic functions, and 35.4% strongly agreed. Conversely, 7.1% of respondents disagreed that weekend/winter school affects the learners' performance in quadratic functions, and 5% strongly disagreed. Those who were not sure of the idea were 6%. The results suggest that weekend/winter school affects the learners' performance in quadratic functions.

The results are consistent with Opper's (2019) suggestion that learners should be encouraged to attend weekend or winter school in order to improve their performance in quadratic functions, among other supposedly difficult Mathematics concepts. Kennedy (2019) agrees, pointing out that weekend/winter school helps learners to fully cover concepts they did not adequately cover during the term, and hence improve their performance. Cerbito (2020) argues that in essence, weekend or winter schools are revision undertakings meant to update what lags behind. Choi

(2019) states that one way of improving the learners' performance is to have them attend weekend or winter school. The results indicate that weekend/winter school is one of the factors that affect learner performance in quadratic functions.

4.3.30 Teacher attitude towards quadratic functions contributes to learners' performance

Teachers are known as the shining light in the learners' lives. Learners see teachers as the epitome of success, good life, and progressive individuals in society. In this case, their attitude towards Mathematics means a lot to the learners' performance at school. The respondents' response results are presented in Table 4.32.

Table 4.32: Teacher attitude towards quadratic functions and learner performance.

Response	Frequency	Percentage
Strongly agree	59	59.7
Agree	32	32.3
Neutral	3	3.0
Disagree	4	4.0
Strongly disagree	1	1.0
Total	99	100

Table 4.32 presents results that show 59.7% of the respondents strongly agreed the teachers' attitude towards quadratic functions contributes to the learners' performance, while 32.3% agreed with the statement. Only 4% and 1% disagreed and strongly disagreed respectively with the statement that the teachers' attitude towards quadratic functions contributes to the learners' performance. Those who were not sure

of the statement were 3%. The results indicate that the teachers' attitude towards the quadratic functions contributes to the learners' performance.

The results are in line with Celik and Guzel's (2019) supposition that the way teachers treat or regard Mathematics has far-reaching consequences on the learners' performance in class. Choi (2019) acknowledges that teachers tend to have a negative attitude towards Mathematics, and this negatively affects the learners' performance as they also tend to see the subject in a bad light. Cerlik and Guzel (2019) concur by pointing out that teachers are sometimes to blame for the learners' negative attitude towards quadratic functions as they continuously feed the latter with the false narrative that Mathematics is a difficult subject that is only done by brilliant individuals. Klassen et al. (2021); Moyana (2016) bemoan the fact that learners are at the teachers' mercy at school since they accept any position the latter take on any subject. The results suggest that the teachers' attitude towards quadratic functions is one of the factors that affect learner performance.

4.3.31 Teachers are competent to teach quadratic functions

Mathematics teachers are supposed to be competent in teaching quadratic functions, otherwise, there is no need for them to be Mathematics teachers if not. The respondents' response results are presented in Table 4.33.

The results presented in Table 4.33 show that the majority of respondents (63.6%) agreed teachers are competent to teach quadratic functions, and 23.2% strongly agreed with the idea. However, 8.1% of respondents disagreed teachers are competent to teach quadratic functions. Only 5.1% were not sure of the idea. The results indicate that teachers are competent to teach quadratic functions.

Table 4.33: Teachers and quadratic functions teaching in class.

Response	Frequency	Percentage
Strongly agree	23	23.2
Agree	63	63.6
Neutral	5	5.1
Disagree	8	8.1
Strongly disagree	0	0
Total	99	100

The results are consistent with Opper (2019); Frydaki and Mamoura's (2011) argument that the majority of teachers joined the teaching profession because they were competent enough to teach the subject for which they were trained. Celik and Guzel (2019) acknowledge that those competent in their subjects are seen through their learners scoring high marks at school. Celik and Guzel (2019) reveal that teachers who are competent in Mathematics are popular among learners at school.

Also, Celik and Guzel (2019) point out that the teacher's competency should be understood from the learners' high pass rates in Mathematics. Klassen et al. (2021) suggest that teachers who are competent in teaching Mathematics are exemplified by their schools' good national results in Mathematics. The results suggest that Mathematics teachers compete in teaching the subject, and this affects the learner performance.

4.3.32 Teachers are knowledgeable in quadratic functions

Mathematics teachers should have knowledge of quadratic functions if they are to effectively teach learners. There is no doubt that knowledgeable teachers are suitable to teach quadratic functions. In short, one cannot teach quadratic functions if one is not knowledgeable in the concept. The respondents' response results are presented in Table 4. 34.

Table 4.34: Teachers' knowledge in quadratic functions.

Response	Frequency	Percentage
Strongly agree	31	31.3
Agree	62	62.6
Neutral	6	6.1
Disagree	0	0
Strongly disagree	0	0
Total	99	100

Table 4.34 presents results showing 62.6% of the respondents agreed that teachers are knowledgeable in quadratic functions, while 31.3% strongly agreed. In contrast, no respondents disagreed or strongly disagreed with the statement. Only 6.1% were not sure of the statement. The results suggest that teachers have knowledge of quadratic functions, and hence are capable of teaching the concept well.

The results are consistent with Klassen et al. (2021); Mji and Makgato (2016) who assert that the bulk of Mathematics teachers are knowledgeable in quadratic functions as it is one of the major concepts that are taught to learners in Mathematics. Silver et al. (2009) agree that Mathematics teachers have knowledge of quadratic functions, and that is why they teach the concept in the first place. Sylva et al. (2009) explain that teachers who understand quadratic functions are those who teach the concept effectively. Christie and Morris (2019); Makamure (2016) acknowledge that it is rare to find a teacher who is not knowledgeable in quadratic functions who teaches Mathematics. Conversely, McGar (2020); Sorensen (2013) argue that there are teachers who have knowledge in quadratic functions but cannot teach the concept well. The results indicate that the teachers' knowledge in quadratic functions is one of the factors that affect learner performance in Mathematics.

4.3.33 Teachers' extra support affect learners' performance in a quadratic functions

Teachers, in the context of their job, are meant to support learners in class. However, there are those who go the extra mile to provide extra support to their learners. Extra support is meant to improve the learners' performance in class. The results obtained from the respondents' responses are presented in Table 4.35.

Table 4.35: Teachers' extra support in quadratic functions and learner performance.

Response	Frequency	Percentage
Strongly agree	57	57.6
Agree	31	31.3
Neutral	3	3.0
Disagree	4	4.0
Strongly disagree	4	4.0
Total	99	100

The results presented in Table 4.35 show the majority of respondents (57.6%) strongly agreed that teachers' extra support affects the learners' performance in quadratic functions, and 31.3% agreed with the statement. But, 4% of the respondents disagreed that the teachers' extra support affects the learners' performance in quadratic functions, and 4% strongly disagreed with that. Only 3% were not sure of the idea. The results suggest that the teachers' extra support affects the learners' performance in quadratic functions.

The results are in line with Ruli et al. (2018) who point out that teachers are commended for providing extra support to learners to improve their performance in Mathematics. McGarr (2020); Kerans (2014) found that every support teachers provide to learners affects their performance in one way or the other. Hill et al. (2016) illustrate that learners who receive extra support from their teachers perform better than those who do not get such support. Moyana (2016) mentions that learners need the teachers' extra support if they are to do well in Mathematics. Opper (2019) admits that there are teachers who provide extra support to their learners, and this has helped improve their performance in Mathematics. The results indicate that the teachers' support to learners is one of the factors that affect their performance in Mathematics.

4.3.34 Instructional materials are adequate to teach quadratic functions

Schools should have enough instructional materials for effective teaching and learning to take place in class. This should not only be the case with quadratic functions but in all subjects across the school curricula. However, as quadratic functions are deemed by many teachers as difficult to teach, there is a need for schools to have enough instructional materials to help learners grasp the concept.

The results presented in Table 4.36 show the majority of respondents (53.5%) agreed that instructional materials at their schools are adequate to teach quadratic functions, and 34.4% strongly agreed with the statement. In contrast, 7.1% of the respondents disagreed that the instructional materials in their schools are adequate to teach quadratic functions, while 3% strongly disagreed with the statement. Only 2% of the respondents were not sure of the idea. The results indicate that schools have adequate instructional materials for teaching quadratic functions.

The results are consistent with Beilock et al.'s (2017) advocacy for the provision of enough materials to schools for teachers to effectively teach quadratic functions. Schoenfeld (2008) alludes to the fact that in general, schools have enough instructional materials to effectively teach quadratic functions and other Mathematics concepts. But, Choi (2019) touches on the issue of public schools struggling to get adequate instructional materials for Mathematics and other science subjects. Klassen et al. (2021) warn of the need to take Mathematics seriously by providing adequate instructional materials to schools. Good and Lavigne (2018) reason that if schools have adequate instructional materials, learners are assured of effective learning. The results suggest that the adequacy of instructional materials in schools is one of the challenges teachers face when teaching quadratic functions.

Table 4.36: Instructional materials in teaching quadratic functions.

Response	Frequency	Percentage
Strongly agree	34	34.4
Agree	53	53.5
Neutral	2	2.0
Disagree	7	7.1
Strongly disagree	3	3.0
Total	99	100

4.3.35 Quadratic function topics are related to real-life situations

Mathematics is one of the subjects that relate to our everyday activities given that we deal with figures almost on a daily basis. If is, therefore, no surprise that quadratic function concepts are a typical example of how Mathematics fits in well with what we do every day. The respondents' results are presented in Table 4.37.

Table 4.37: Quadratic functions and real-life situations.

Response	Frequency	Percentage
Strongly agree	25	25.3
Agree	34	34.3
Neutral	7	7.1
Disagree	30	30.3
Strongly disagree	3	3.0
Total	99	100

Table 4.37 presents results showing 34.3% of the respondents agreed that quadratic function topics relate to real-life situations, and 25.3% strongly agreed with the statement. Inversely, 30.3% of the respondents disagreed that quadratic function topics relate to real-life situations, and 3% strongly disagreed with the statement. Only

7.1% of the respondents were not sure of the idea. The results indicate that teachers see the quadratic function topics as being related to real-life situations.

The results are in line with Klassen et al.'s (2021); Mullis et al.'s (2010) argument that Mathematics is one of the subjects that have real-life situations tag on them. Good and Lavigne (2018) add that Mathematics is what we do in our everyday transactions, and hence should be understood by learners along these lines. Akhtar (2014) admits that quadratic function topics are reflective of what we engage in, in real life. Goodnough et al. (2009) opine that what we teach in class should be reflective of our ways of life. Kazem (2013) illustrates that education should be linked to our ways of life, otherwise it would lose its essence. The results indicate that teachers face challenges such as the quadratic function topics' relatedness with our everyday activities.

4.3.36 Frequent monitoring should improve learner performance

Learners are hyper-active when among each other. This makes them ignore their school work as they play a lot. Teachers are advised to frequently monitor their learners if they are to concentrate on their studies. Once learners concentrate on their work, it becomes easy for them to improve in their performances. The respondents' response results are represented in Table 4.38.

Table 4.38: Frequent monitoring and improvement of learner performance.

Response	Frequency	Percentage
Strongly agree	66	66.7
Agree	31	31.3
Neutral	0	0
Disagree	2	2.0
Strongly disagree	0	0
Total	99	100

The results presented in Table 4.38 show majority of respondents (66.7%) strongly agreed that frequent monitoring should improve the learners' performance in class, while 31.3% agreed with the statement. However, 2% of the respondents disagreed with the idea that frequent monitoring should improve the learners' performance at school. The results suggest that teachers believe that the frequent monitoring strategy improves the learners' performance in quadratic functions.

The results are in line with Cerbito (2020) who suggests that learners need constant monitoring if they are to improve their performance in class. Kennedy (2019) found that teachers who frequently monitor their learners get the best out of them. Yusof and Zakaria (2010) agree that one of the ways to improve the learners' performance is to frequently monitor their work. Kennedy (2019) decries the lack of frequent monitoring of learners given that it is one of the ways teachers can find out whether learners do their work correctly or not. Peel (2020) adds that the constant monitoring of learners helps improve their academic performance. The results indicate that learners' frequent monitoring improves their performance in Mathematics.

4.3.37 Frequent feedback can improve learners' performance

Feedback is one of the ways by which learners know how they performed in a given task. As such, if feedback is given frequently or timeously, the learners' performance is likely to improve. The respondents' response results are presented in Table 4.39.

Table 4.39: Frequent feedback and improvement of learner performance.

Response	Frequency	Percentage
Strongly agree	79	79.8
Agree	16	16.2
Neutral	2	2.0
Disagree	2	2.0
Strongly disagree	0	0
Total	99	100

The results presented in Table 4.39 show the majority of respondents (79.8%) strongly agreed that frequent feedback can improve the learners' performance, and 16.2%

agreed with the statement. But, 2% of the respondents disagreed that frequent feedback can improve the learners' performance. Only 2% were not sure of the idea. The results suggest that teachers embrace the idea of giving learners feedback frequently.

The results are consistent with Sorensen's (2021) idea that feedback that is given timeously encourages learners to work hard as they anticipate more feedback for their work. Flockton and Cunningham (2020) conclude that feedback that is given on time is a morale booster to learners' zeal to work harder in class. Mamali (2015) advises against the teachers' failure to give feedback timeously as such oversight might lead to learners not taking their work seriously. Giving learners frequent and timely feedback is the constructivism theory's corner stones. Cerbito (2020) concurs by indicating that learners who wait for far too long for feedback lose interest in their studies. The results indicate that frequent feedback is one of the positive challenges teachers face in teaching quadratic functions.

4.3.38 Spending more time on tasks should help learners master quadratic function skills

Learners who are allowed to spend more time on tasks easily master quadratic function skills. In this regard, teachers should allow learners to spend more time doing quadratic function tasks so that they master related skills. The respondents' response results are presented in Table 4.40.

Table 4.40: Spending additional time on tasks and learners mastering quadratic functions.

Response	Frequency	Percentage
Strongly agree	57	57.6
Agree	40	40.4
Neutral	2	2.0
Disagree	0	0
Strongly disagree	0	0
Total	99	100

The results presented in Table 4.40 show the majority of respondents (57.6%) strongly agreed that spending more time on tasks should help learners master quadratic function skills, and 40.4% agreed with the statement. Only 2% of the respondents were not sure of the idea. The results suggest that teachers allow learners to spend more time on tasks as a strategy that helps them master quadratic function skills.

The results are consistent with Good and Lavigne (2018) who argue that learners should be given enough time to do tasks so that they master them. Jones (2012) found that learners who are afforded enough time to do their tasks usually score high marks in tests or examinations as they have mastered what they were taught. Flockton and Cunningham (2020); Zakaria and Zaini (2009) state that rushing learners to complete their tasks leaves them with half-finished tasks, thereby compromising their examination preparedness. Spending more time on tasks in line with the constructivism theory's premise that learners should be given enough time to construct meaning from what they learn. Good and Levigne (2018) assert that teachers who consider the learners' plight in requesting for more time to do their work are seen as effective in their teaching strategies. Christie and Morris (2019 point out that only through affording learners enough time to do their class tasks can teachers be seen to be sensitive to the formers' needs. The results indicate that giving learners more time to do their tasks is one of the strategies teachers use to improve their performance in Mathematics.

4.3.39 Learning environment should be conducive for effective teaching and learning to take place

Whatever happens in class should be favourable to the teaching and learning process. That is, the classroom environment should be conducive if the teaching and learning process are to be done effectively. The respondents' responses are presented in Table 4.41.

Table 4.41 presents results that show 65.7% of the respondents strongly agreed that the learning environment should be conducive for effective teaching and learning to take place, while 30.3% agreed with the idea. Only 2% of the respondents disagreed that the learning environment should be made conducive for teaching and learning to take place. Another 2% were those who were not sure of the statement. The results indicate that teachers strive to make the learning environment conducive so that the teaching and learning process is done effectively.

Table 4.41: Learning environment and effective teaching and learning.

Response	Frequency	Percentage
Strongly agree	65	65.7
Agree	30	30.3
Neutral	2	2.0
Disagree	2	2.0
Strongly disagree	0	0
Total	99	100

The results are in line with Christie and Morris' (2019) supposition that teachers' responsibilities include creating a conducive learning environment so that the teaching and learning process is effective. Opper (2019) illustrates that when learners are happy in class, they enjoy the class activities therein, and hence participate fully. Kahah et al. (2013) see the effective teaching and learning process as the culmination of a friendly atmosphere in class. McGarr (2020) points out that a classroom atmosphere that depicts fear and misery does not auger well for the effective teaching and learning process. Sunbul and Gordesli (2021) note that good classroom managers are known for creating a vibrant teaching and learning environment. This is suggestive of the constructivism's claims that effective learning takes place when the environment is conducive for learner participation. The results indicate that making the learning environment conducive to teaching and learning is one of the strategies teachers embrace for the improvement of the learners' performance in quadratic functions.

4.3.40 Learners should be given extra-hard work to improve their foundation

Hard work is one of the key factors that help learners improve their understanding of the concepts taught. Understanding concepts is dependent on the learners' foundation in that particular subject. A strong foundation is the bedrock of the learners' improved understanding of concepts taught.

Table 4.42: Learners and extra hard work to improve their quadratic functions foundation.

Response	Frequency	Percentage
Strongly agree	64	64.7
Agree	31	31.3
Neutral	2	2.0
Disagree	2	2.0
Strongly disagree	0	0
Total	99	100

The results presented in Table 4.42 show the majority of respondents (64.7%) strongly agreed that learners should be given extra-hard work to improve on their foundation, and 31.3% agreed with the idea. However, 2% of the respondents disagreed that learners should be given extra-hard work to improve on their foundation. Those who were not sure of the idea were 2%. The results suggest that teachers give learners extra-hard work to solidify their quadratic function foundation.

The results are consistent with Good and Lavigne's (2018) argument that if learners are not given difficult tasks, they are likely not to take their work seriously, and this might have negative effects in the future. Sunbul and Gordesli (2021) explain that hard work makes learners concentrate on their school work as they would have little time to play. Sorensen (2021) admits that giving learners extra-hard work is one of the several ways they could be motivated to take their work seriously. Good and Lavigne (2018) assert that the importance of working hard in class is realised when learners obtain excellent results at the end of the year. Flockton and Cunningham (2020) note that extra-hard work helps learners improve on what they already know. The results indicate that teachers give learners extra-hard work to improve their performance in quadratic functions. This is consistent with the constructivism theory that concerns itself with involving learners in classroom activities.

4.3.41 Learners should be more involved in practical work than the theoretical one

Practical work is mainly putting into practice what one was told through the word of mouth. Doing practical work is part of learning, and learners involved in such exercises do not easily forget what they did. In this respect, it is advisable to let learners do more practical work than its theoretical aspect.

Table 4.43: Learners, practical work, and theory in quadratic functions.

Response	Frequency	Percentage
Strongly agree	59	59.6
Agree	28	28.3
Neutral	10	10.1
Disagree	2	2.0
Strongly disagree	0	0
Total	99	100

Table 4.43 presents results showing most respondents (59.6%) strongly agreed learners should be more involved in practical work than in theoretical one, and 28.3% agreed with the idea. However, only 2% disagreed with the statement that learners should be more involved in practical work than its theoretical counterpart. Those who were not sure of the statement were 10.1%. The results suggest that teachers involve learners in practical work more than in theory. This is in line with the constructivism theory that posits that learners create knowledge from what they do.

The results are consistent with the fact that practical work is more favoured by most teachers than the theoretical aspect of teaching (Mji & Makgato, 2016). Sorensen (2021) is of the view that once learners are allowed to do more practical work than its theoretical aspect, chances are that what they learn is solidified than ever before. Moyana (2016) testifies to the fact that practical work enhances the learners' understanding of what they learn as opposed to mainly relying on the theoretical aspect of teaching. Good and Lavigne (2018) said that learners who are involved in practical work more often do not forget what they learned. Choi (2019) emphasises the importance of practical work when he called for more teachers to address its lack thereof in their teaching. The results indicate that teachers prefer involving learners in practical work than in theory as a strategy that improves their performance in quadratic functions.

4.3.42 Parents should buy necessary learning materials for their children

Learning materials are part of the items learners should have if they are to do well at school. Not all schools can provide these to their learners. As a result, it is the duty of every parent to ensure that their children have these when they go to school.

The results presented in Table 4.44 show the majority of respondents (70.8%) strongly agreed that parents should buy necessary learning materials for their children, while 24.2% agreed with the statement. Conversely, 1% of the respondents disagreed that parents should buy necessary learning materials for their children. Only 4% of the respondents were not sure of the statement. The results suggest that learning materials are necessary for teaching quadratic functions.

Table 4.44: Parents and learning materials for their children.

Response	Frequency	Percentage
Strongly agree	70	70.8
Agree	24	24.2
Neutral	4	4.0
Disagree	1	1.0
Strongly disagree	0	0
Total	99	100

The results are in line with Ruli et al. (2018) who advise school authorities to encourage parents to buy necessary learning materials required by schools. Klassen et al. (2021) state that one of the parents' duties towards their children's education is to make sure that they have the necessary learning materials when they go to school. Ruli et al. (2018) argue that it is the parents' responsibility to buy learning materials for their children. Sunbul and Gordesli (2021); Mayer and Kloehler (2009) postulate that in addition to ensuring that children go to school in proper school uniform, parents are encouraged to provide them with necessary learning materials, particularly those in short supply at school. The results indicate that one of the ways of improving learner performance in quadratic functions is for learners to have necessary learning materials at school.

4.3.43 Learners should be willing to learn on their own

Part of learning involves the learners' dedication to learning on their own without either the teacher or parental interference. Learners should be willing to do so, otherwise, it is pointless for them to pretend as if they are doing so when in actual fact they are not. The respondents' response results are presented in Table 4.45.

The results presented in Table 4.45 show 79.8% of the respondents strongly agreed learners should be willing to learn on their own, and 19.2% agreed with the statement. Only 1% of respondents were not sure of the statement. The results suggest that teachers believe that only through their willingness to learn on their own could learners improve their performance in quadratic functions.

Table 4.45: Learners' willing to learn alone.

Response	Frequency	Percentage
Strongly agree	79	79.8
Agree	19	19.2
Neutral	1	1.0
Disagree	0	0
Strongly disagree	0	0
Total	99	100

The results are consistent with Ruli et al's. (2018) position that learners are supposed to be willing to learn on their own if they are to understand what they were taught in class. Kennedy (2019) alludes to the fact that learners who are prepared to learn on their own are those who are serious with their education. Learning on their own is one of the strategies that teachers should employ if they are to make learners independent scholars (Ruli et al., 2018). Peel (2020) acknowledges the positives of learners who are willing to learn on their own as this helps them discover their strengths and weaknesses. Sunbul and Gordesli (2021) argue that not all learners learn better under the teachers' instructions, noting that there are those who understand better when left to learn on their own. The results indicate that teachers should make learners like learning on their own as one of the strategies to improve their performance in quadratic functions.

4.3.44 Working in groups can improve learners' performance in a quadratic functions

Group work is part of the teacher's teaching strategy that is meant to enable learners to learn on their own and share ideas. It is advisable, therefore, for teachers to regularly employ this strategy in their teaching.

Table 4.46: Group work and learner performance in quadratic functions.

Response	Frequency	Percentage
Strongly agree	78	78.8
Agree	19	19.2
Neutral	2	2.0
Disagree	0	0
Strongly disagree	0	0
Total	99	100

The results presented in Table 4.46 show the majority of respondents (78.8%) strongly agreed that group work improves the learners' performance in quadratic functions, and

19.2% agreed with the statement. Only 2% of the respondents were not sure of the idea. The results suggest that teachers use group work to improve learner performance in quadratic functions.

The results are in line with Sunbul and Gordesli's (2021) suggestion that teachers should involve children in group work as much as possible as it helps improve their performance, not only in Mathematics but also in other subjects as well. Opper (2019) asserts that learners who are exposed to a lot of group work are likely to perform better than those who are less exposed to it. McGarr (2020) states that teachers who use group work as one of their teaching strategies positively impact the learners' performance in quadratic function. Good and Lavigne (2018) believe that the use of group work in teaching quadratic function lessons allows learners to share ideas without much interference from the teacher. Diaz and Poblete (2018) note that involving learners in group work expands their reasoning capacity as they share ideas independently. The results indicate that teachers employ the group work strategy to improve learner performance in quadratic functions.

4.4 SUMMARY

Data presented and discussed in this chapter shows that group work helps improves the learners' performance in quadratic functions. Learners doing group work share ideas and their understanding of how to solve quadratic function problems as discussed in class among themselves. Data also revealed that learners are willing to learn on their own as long as they are given guidelines on what to do and how to do it. The idea here is to develop the learners' ability to work independently without teachers interrupting their studies. Also, the results suggest that parents need a constant reminder from school authorities to buy Mathematics instruments for their children. The idea here is to enable learners to have Mathematics instruments required to do quadratic function problems, among other Mathematics concepts. It is also necessary to involve learners in practical work more often than in Mathematics' theoretical aspect. This would enable them to understand how to solve quadratic function-related problems as part of Mathematics. The next chapter concludes this study and provides its recommendations. These are informed by the study's research questions and its objectives.

CHAPTER 5: FINDINGS, CONCLUSIONS AND RECOMMENDATION

5.1 INTRODUCTION

This chapter concludes this study. In its concluding endeavours, this study's major findings are outlined, followed by the concluding section, and then the recommendations wrap up the study. It should be emphasised that this study explored the challenges faced by teachers as they teach quadratic functions to Grade 11 learners in the Luvuvhu Circuit. The circuit is in rural areas-cum-farmcommunities. This chapter is made of three sections, namely the study's major findings, conclusion and recommendations.

5.2 MAJOR FINDINGS OF THE STUDY

The major findings are based on this study's research questions.

i) What are quadratic problem-solving skills among those who teach quadratic functions at Grade 11 level in the Luvuvhu Circuit?

a) Teachers' expectations regarding practical work during their university years

The study found that while at university, teachers have certain individual expectations regarding the learners' performance in Mathematics that are largely different from what is expected of them by the DBE, parents and learners. This has a bearing on how they teach Mathematics to high school learners. Thus, once they are eventually deployed as qualified individuals, the same teachers rush into judging the learners' abilities in Mathematics, in the process making costly errors that have a huge bearing on their learning. Consequently, the teachers' failure to realise their expectations leaves them frustrated and with bad attitude towards learners in general. Thus, they fail to teach them effectively.

b) Teachers have a lot of Mathematics content knowledge required to teach at Grade 11 level

The study found that teachers have a lot of Mathematics content knowledge required to teach at Grade 11 level. Such content suffices when properly guided to benefit learners. Conversely, the study found that despite all their content knowledge, teachers have surmountable challenges in class regarding their teaching methodologies, planning, and time management. These negatively affect the teaching and learning process, and hence poor Mathematics results at the end of the year. The study found that there is no effective mentorship from HODs regardless of the challenges faced by teachers.

c) Teachers should be highly knowledgeable in their subject as this helps them teach effectively.

The study found that teachers need to be highly knowledgeable in their subject area if the teaching and learning is to be effective. Indeed, this study found that most teachers have sound knowledge about quadratic functions but learners perform poorly in this area of Mathematics. This study found that regardless of their understanding of quadratic function, teachers fail to effectively teach the concepts due to factors such as attitude, laziness, overcrowded classrooms, and resource shortages, inter alia.

ii) What are factors that affect learner performance in Mathematics' quadratic functions in the Luvuvhu Circuit?

a) Schools do not have environments that are suitable for the teaching and learning of quadratic functions

The study found that schools do not have environments that are conducive for the teaching and learning of quadratic functions, thereby affecting the learners' performance in the concept. This is particularly prevalent in schools with big student enrolments. That is, schools have large classes that often result in overcrowded classrooms where teachers have difficulties to effectively manage learners, thereby neglecting slow learners who require their attention the most.

b) The issue of overcrowded classrooms

Overcrowding was found to be one of the biggest problems in most schools. That is, schools have big classes that lead to overcrowding and this affects the teacher's class management abilities given that there would be too many learners in a single classroom. As a result, chaotic scenes prevail in such classes that adversely affect the learners' learning of quadratic functions.

c) The issue of the teaching methodologies in these schools

The major finding in this aspect was that most teachers rely on group work informed by Mathematics computations. Teachers do not vary their teaching methods, thereby failing to cater to other learners who are not comfortable learning through the group work method. It was found that this negatively affect learners who cannot cope with group activities such that they become hesitant to attend Mathematics lessons.

d) The teaching environment in most schools is not conducive for learners to effectively learn quadratic functions

The study found that the teaching environment in most schools is not conducive to learners to effectively learn quadratic functions. That is, there is no teaching and learning equipment for quadratic functions, classrooms are noisy, and teachers are not friendly. As a result learners do not attend such classes as they see no reason to do so given that they benefit nothing at the end of the year.

iii) **Which challenges Mathematics teachers are faced with in teaching quadratic functions at Grade 11 level?**

a) Learners have negative attitudes towards quadratic functions

Another major finding is that learners have negative attitudes towards quadratic functions. This complicates the teaching and learning process and hence affects the overall Mathematics pass rate at school. Teachers are then blamed for poor results.

b) Too much curriculum changes

It was also found that there have been a lot of curriculum changes of late, and this contributes to the learners performing poorly in quadratic functions due to the inherent confusion associated with curriculum change of any form. Consequently, curriculum changes were found to have negative effects on the learners' performance instead of improving the learners' understanding of Mathematics as is the intentions thereof.

c) Learners refuse to learn Mathematics in general

The study found that in general, learners do not want to do Mathematics. This is realised by their refusal to do quadratic functions related work given by teachers. It is difficult for teachers to effectively teach learners who refuse to participate in class, do not do class or homework, and largely do not attend Mathematics lessons. These are some of the challenges teachers face as they teach quadratic functions.

5.3 CONCLUSION

Based on data discussions and interpretation in chapter four and the preceding section, this study concludes that the process of teaching and learning in Mathematics at the Luvuvhu Circuit faces a lot of challenges. In this case, the study concludes that most of the challenges were school and teacher centred, and those that were learner centred were less. There are not many challenges between teachers and their learners in the context of informed engagements. That is, one of the challenge is here is that lessons are teacher-centred as opposed to being learner-centred. This brings another challenge, that of the less involvement of the principals, yet they are supposed to be the resource providers to both teachers and learners. This has left several schools with a challenge of ill-equipped teachers and learners. The latter creates another challenge where teachers and learners desperately need instructional resources and materials. We must not lose sight of the fact that principals are the schools' financial gatekeepers, yet they seem to be found wanting in exercising their authority and order for the well-needed resources and materials for the effective teaching and learning to take place in this circuit.

The effective teaching of quadratic functions cannot and should not solely be made the prerogative of the school principals only. If learners are to do well in Mathematics at the Matric level, the Department of Education, District and Circuit Managers, and the SGBs should come together and play their part. All must collectively commit to helping the schools improve their Mathematics pass rates by enabling them to acquire modern equipment and infrastructure necessary to motivate learners as they study Mathematics and other subjects at school. If learners improve their Mathematics pass rate, the country would benefit in terms of learners taking up science-related studies at the university level. In this way, the country would be able to produce its own scientists instead of relying on foreign nationals in this respect.

That said, effective teaching is not the only determinant for learners to perform well in quadratic functions at Grade 11 level. Other factors also affect how learners perform in Mathematics as well. One such factor is the curriculum change that bedevils our education system from time to time. This significantly throws the learners' understanding of concepts out of the window as confusion reigns amidst such changes. The curriculum change, necessary as it might be, should be progressively done, and must take into consideration the learners' needs as opposed to the policy makers' needs.

The country's independence ushered in a new leaf in our education system as most previously segregated black people found their way to school. This saw a lot of black children becoming educated, something that had been a preserve of the white population and the privileged few black people. This brought its own calamity to schools as classes suddenly ballooned, leading to overcrowding and understaffing. This has since remained an Achilles Heel in most black rural communities, the Luvuvhu Circuit being a case in point here. This saw large classes prohibiting teachers from delivering their lessons effectively.

Based on this study's findings, it was noted that successful teachers do not practice most aspects of the pedagogical content knowledge. Having a good knowledge of the quadratic functions makes for successful teaching but it is dependent on the teaching approach one opts for. That is, teachers teach quadratic functions according to their understanding, belief, and how it should be taught.

The teaching and learning of Mathematics are complicated and thus challenging to the less experienced teachers. This has forced all those involved in the teaching of Mathematics to consistently formulate strategies meant to improve its teaching and learning. This has seen the introduction of Mathematics laboratories at the Intermediate Phase. The idea is to facilitate Mathematics' effective teaching and learning.

Thus, it is important to note that this study managed to fulfill its mandate in the process of identifying challenges teachers face as they teach quadratic functions to Grade 11 learners at the Luvuvhu Circuit's secondary schools. It is important to note that given what was presented and discussed in the fourth chapter and this one's first two sections, this study achieved its objectives as it effectively answered all its research questions. The succeeding section is more telling in this aspect.

5.4 THE STUDY'S RECOMMENDATIONS

The following constitute this study's recommendations. These are based on the study's research questions.

- The first recommendation is that teachers should be in-serviced in order to acquire problem-solving teaching skills in quadratic functions. Also, workshops should be arranged from time to time to keep Mathematics teachers abreast with new teaching strategies for their competence. In-service training and workshops should be prioritised given that we are living in a world of the ever-changing and evolving education system, particularly when one considers issues to do with blended teaching.

- It is recommended that the DBE provides adequate infrastructure and learning materials to all schools in the Luvuvhu Circuit to avoid a situation where teachers teach in overcrowded and poorly equipped classrooms. Only through using well-equipped facilities can learners enjoy their time at school.

- The study also recommends that the circuit manager should facilitate the sharing of available resources and facilities within his circuit to help the poorly resourced schools. This would help them use some of the state-of-the-art equipment and facilities they do not have.

- Another recommendation is that other scholars should take up similar studies in other circuits within the district in order to have a comprehensive understanding of how quadratic functions are handled in the Vhembe District. The resultant picture would help the district formulate its internal policies that govern Mathematics teaching and learning, given that this is a rural district. Also, there is a need to assess whether other studies would yield similar results in view of the phenomenon studied.

- Given that this study dealt with the learners' performance in quadratic functions at Grade 11 level, there is a need to have other similar studies to investigate learner performance in other grades as well. This would significantly contribute to the general improvement of Mathematics teaching in secondary schools.

- The last recommendation relates to the new curriculum and its implementation. In this case, teachers have difficulties in dealing with the operationalisation of most concepts in the quadratic functions. It is recommended that teachers be given extra training on operationalising the said concepts.

LIST OF REFERENCES

Adler, J. (2015). Mathematics for teaching: What is it and why is it important that we talk about it? *Pythagoras*, 62. pp. 1-11.

Adler, J. & Pillay, V. (2017). Mathematics Education in South Africa, in Adler, J. & Sfard, A. *Research for Educational Change:Transforming researchers' insights into improvement in Mathematics teaching and learning.* New York: Routledge.

Agyei, D.D. & Voogt, J. (2010.) ICT use in the teaching of mathematics: Implications for professional development of pre-service teachers in Ghana, in *Education and Information Technologies*, 16(4). pp. 423-439.

Ajibade, Y.A., Oloyede, E.O. & Adeleke, M.A. (2010). Teachers' views on and attitudes to pedagogical skills training: Obafemi Awolowo University as a case study, in *Review of Higher Education in Africa*, 2(1). pp. 45-64.

Akhtar, M. (2014). Effects of teachers' comments and expectations on the learning experience of learners, in *International Journal of Physical and Social Sciences*, 4(3). pp. 324-335.

Alvior, M. (2014). *The Meaning and Importance of Curriculum Development*. Retrieved October 17, 2016, from simply-educate-me: http://simplyeducate.me/2014/12/13/the-meaning-and-importance-ofcurriculum-development/

Ambrose, R. (2014). Initiating change in prospective elementary school teachers' orientations to mathematics teaching by building on beliefs, in *Journal of Mathematics Teacher Education*, 7(2), pp. 91-119.

Anthony, G. & Walshaw, M. (2009). Characteristics of Effective Teaching of Mathematics: A View from the West. *Journal of Mathematics Education,* 2(2). pp. 147- 164.

Bajaña, C. (2019). *Didactic proposal for teaching quadratic equations and functions through the use of "Desmos Graphing Calculator"* (*Propuesta didáctica para la enseñanza de funciones y ecuaciones cuadráticas, a través del uso de).* (Bachelor), Universidad de Cuenca, Ecuador.

Ball, D.L., Lubienski, S. & Mewborn, D. (2011). Research on teaching Mathematics: The unsolved problem of teachers' Mathematical knowledge, in Richardson, V. (Ed), *Handbook of research on teaching*. 4th ed., pp. 433-456. Washington, DC: American Educational Research Association.

Ball, D.L., Thames, M.H. & Phelps, G. (2008). Content knowledge for teaching: What makes it special, in *Journal of Teacher Education*, 59(5). pp. 389-407.

Barry, N.H. & Lechner, J.V. (2009). Pre-service teachers' attitudes about and awareness of multicultural teaching and learning. *Teaching and Teacher education*, 11. pp. 149-161.

Beilock, S. L., Schaeffer, M. W. & Rozek, C. S. (2017). Understanding and addressing performance anxiety, in Elliot, A.J., Dweck, C.S. & Yeager, D.S. (Eds.), *Handbook of competence and motivation: Theory and application* (p. 155-172). New York: The Guilford Press.

Bekdemir, M. (2010). The pre-service teachers' mathematics anxiety related to depth of negative experiences in mathematics classroom while they were learners. *Educational Studies in mathematics,* 75. pp. 311-328.

Borko, H., Peressini, D., Romagnano, L., Knuth, E., Willis-Yorker, C., Wooley, C. & Masarik, K. (2010). Teacher education does matter: A situative view of learning to teach secondary Mathematics, in *Educational Psychologist*, 35(3). pp. 193-206.

Briley, J.S. (2012). The relationships among mathematics teaching efficacy, mathematics self-efficacy and mathematics beliefs for elementary preservice teachers: Issues in the Undergraduate Mathematics Preparation of School Teachers, in *The Journal,* 5. pp. 1-13.

Çelik, Ö. & Güzel, B. (2019). An instructional sequence triggering students' quantitative reasoning during learning of quadratic functions, in the *Turkish Journal of Computer and Mathematics Education*, 10(1). pp. 157-194. https://doi.org/10.16949/turkbilmat.446403

Cerbito, A. (2020). Comparative analysis of mathematics proficiency and attitudes toward Mathematics of senior high school student 2020, in *International Journal of Scientific and Research Publications*, 10(5). pp. 211-222. https://doi.org/10.29322/IJSRP.10.05. 2020.p10125.

Choi, L.J. (2019). The identity (re) construction of international students in the process of academic literacy acquisition, in Journal of Azores, 10(1). pp. 55-72.

Christle, H. & Morris, N. (2019). *Using assessed blogs to enhance student engagement*. Guelph, University of Guelph Press.

Cobb, P., Yackel, E. & Wood, T. (2009). A Constructivist Alternative to the Representational View of Mind*, in Mathematics Education,* 19. pp. 99-114.

Cooper, P. & McIntyre, D. (2008). *Effective teaching and learning. Teachers and learners' perspectives.* London, Open University Press.

Depaepe, F., Verschaffel, L. & Kelchtermans, G. (2013). Pedagogical content knowledge: A systematic review of the way in which the concept has pervaded mathematics educational research, in *Teaching and Teacher Education,* 34(34). pp. 12-25.

Department of Education (2009). *National Curriculum Statement (NCS). Mathematics***.** Pretoria, Department of Basic Education: Government Printing Works.

Department of Education (2011). *Curriculum and Assessment Policy Statement (CAPS). Mathematics Senior Phase***.** Pretoria, Government Printing Works.

Department of Education (2012). National Senior Certificate Examination (NCS): *National Diagnostic Report on Learner Performance***.** Pretoria: Government Printing Works.

Díaz, V. & Poblete, A. (2018). Use of didactic models of the teachers mathematics in the teaching of logarithmic, quadratic and exponential functions (Uso de modelos didácticos de los docentes de matemáticas en la enseñanza de funciones logarítmicas, cuadráticas y exponenciales), in *Paradigma*, 39(1). pp. 353-372.

Diko, N. & Feza, N. (2014). Training of Mathematics teachers in a South African university, in *Mediterranean Journal of Social Sciences*, 5(23). pp. 14561464.

Esquer, M. P., Robles, A., Cosmes, S., & Ansaldo, J. (2017). Didactic proposal with quadratic functions of problems in context at a higher level [Propuesta didáctica con funciones cuadráticas de problemas en contexto a nivel superior]. In F.Rodríguez & R. Rodríguez (Eds.), *Memoria de la XVII Escuela de Invierno en Matemática Educativa.* Oaxaca: Red Cimates.

Farez, M. (2018). Solving quadratic functions through the use of learning objects by second year high school students, in the feedback phase (Resolución de funciones cuadráticas mediante el uso de objetos de aprendizaje por parte de estudiantes de segundo año de bachillerato, en la fase de retroalimentación). (Master's Dissertation), Universidad de Cuenca, Ecuador.

Fennma, E. & Romberg, T. (2014). *Mathematics Classrooms that Promote Understanding.* New Jersey: Lawrence Erlbaum Associates Publishers.

Flockton, G. & Cunningham, C. (2020). Teachers' perspectives on preparing student teachers work with pupils who speak languages beyond England. pp. 1- 14.

Franke, M.L. & *Kazemi*, E. (2013). Learning to teach mathematics: Focus on learner thinking, in Journal of *Theory to Practice*, 40(2). pp. 102-109.

Fried, L. (2011). Teaching teachers about emotion regulation in the classroom, in *Australian Journal of Teacher Education*, 36(3). pp. 1-11.

Frydaki, E. & Mamoura, M. (2011). How can practicum experience transform preservice teachers' knowledge about teaching and learning, in *The International Journal of the Humanities*, 9(1). pp. 225-236.

Gleason, J. (2010). Reliability of the content knowledge for teaching-mathematics instrument for pre-service teachers, in *Issues in the Undergraduate Mathematics Preparation of School Teachers*, 1. pp. 1-12.

Good. T.L. & Lavigne, A.L. (2018). *Looking in classrooms* (11th Ed.). New York: Routledge. https://doi.org/10.4324/9781315627519

Goodnough, K., Osmond, P., Dibbon, D., Glassman, M. & Stephens, K. (2009). Exploring a triad model of learners teaching: Pre-service teachers.

Gosnell, J.C. (2012). Academic self-efficacy, faculty-learner interactions learner characteristics as predictors of grade point average. Unpublished PhD thesis. Miami: Barry University.

Hiebert, J., Morris, A.K. & Glass, B. (2012). Learning to "learn to teach": An "experiment" model for teaching and teacher preparation in Mathematics, in *Journal of Mathematics Teacher Education*, 6. pp. 201-222.

Hill, H.C., Ball, D.L. & Schilling, S.G. (2008). Unpacking pedagogical content knowledge: Conceptualising and measuring teachers' topic specific knowledge of learners, in *Journal for Research in Mathematics Education*, 39(4). pp. 372-400.

Hill, H.C., Rowan, B. & Ball, D.L. (2016). Effects of teachers' mathematical knowledge for teaching on learner achievement, in *American Educational Research Journal,* 42(2). pp. 371-406.

Hine, G.S.C. (2015). Strengthening pre-service teachers' mathematical content knowledge, in *Journal of University Teaching and Learning Practice*, 12(4). pp. 72-90.

Holm, J. & Kajander, A. (2012). Interconnections of knowledge and beliefs in teaching Mathematics, in *Canadian Journal of Science*, *Mathematics and Technology Education*, 12(1). pp. 7-21.

Hudson, P. & Hudson, S. (2010). Mentor teachers' understanding of mentoring preservice primary teachers, in *International Journal of Learning*, 17(2). pp. 157170.

Johnson, J. (2010). *Teaching and Learning Mathematics.* Olympia: Office of Superintendent of Public Instruction.

Johnson, M.L. (2014). Blacks in Mathematics: A Status Report, in *Journal for Research in Mathematics Education,* 15(2). pp. 145-153.

Jones, K. (2012). Issues in the Teaching and Learning of Quadratic Function, in Linda Haggarty (Ed.), *Aspect of Teaching Secondary Mathematics: Perspectives on Practice.* London: Routledge Falmer.

Kahan, J., Cooper, D. & Bethea, K. (2013). The role of mathematics teachers' content knowledge in their teaching: A framework for research applied to a study of learner teachers, in *Journal of Mathematics Teacher Education*, 6(3). pp. 223-252.

Karnasih, I. & Soeparno. (2009). *Teaching Mathematics has to Focus on Logic.* Kualalumpa: Kompas.

Kelly, S.N. (2008). Classroom Teacher's Perceptions of Useful Music Skills and Understandings, in *Journal of Research in Music Education,* 46. pp. 374383.

Kennedy, M.M. (2019). How we learn about teacher learning. Michigan, SAGE.

Kerans, D.S. (2014). *Teaching Algebra at Secondary Schools in Kupang, East Nusa Tengara.* Kualalumpa: Surabaya State University Press.

Kirk, A.J. (2010). *The Peer Effect on Academic Achievement among Public Elementary School Pupils. A Report of the Heritage Centre for Data Analysis.* Washington DC: The Heritage Foundation.

Klassen, R.M., Rushby, J.V., Tracy, L. Durksen, T.L. & Bardach, L (2021). Examining teacher recruitment strategies in England.

Kutama, M.E. (2012). *An Investigating into Processed-based Instruction in the Teaching of Grade 8 and 9 Euclidean Quadratic Function.* Master of Education Dissertation. South Africa: UNISA.

Kutnick, P. & Rogers, C. (2014). *Groups in Schools.* London: Cassell.

MA, X. (2009). The Effect of Informal Oral Testing Frequency upon Mathematics Learning of High School Learner in China, in *Journal of Classroom Interaction,* 30(1). pp. 17-20.

Malcom, C., Keane M., Hoohlo, L., Kgaka, M. & Oven, J. (2010). *People Working Together: A Study of Successful Schools.* Johannesburg: University of Witwatersrand Press.

Maree, J.G. (2011). The Development and Evaluation of a Study Orientation Questionnaire in Mathematics. Unpublished PhD thesis. Pretoria: University of Pretoria.

McGarr, O. (2020). The use of vital simulations in teacher education to develop pre-service teacher' behaviour and classroom management skills: implications for reflective practice, in *The Journal*, 46. pp. 159- 169.

McLeod, D.A. (2012). Research on Affect in Mathematics Education: A Reconceptualization, in D.A Gruos, D.A. (Ed.), *Handbook of Research on Mathematics Teaching and Learning*. New York: Macmillan.

Mevarech, Z. (2012). Learning Mathematics in Different Mastery Environment, in *Journal of Educational Research*, 84(4). pp. 225-231.

Meyer, M.R., & Kloehler, M.S. (2009). Internal Influence on Gender Differences in Mathematics, in Fennema, E. & Leder, G.C. (Eds.), *Mathematics and Gender.* New York: Longman.

Mji, A. & Makgato, M. (2016). Factors associated with high school learners' poor performance: a spotlight on mathematics and physical science. *South African Journal of Education,* Volume 26 (2), pp. 253-266.

Moyana, H.J. (2016). Factors Related to Mathematics Achievement of Secondary School Pupils. Unpublished MEd Dissertation. Pretoria: University of South Africa.

Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Gregory, K.D., Garden, R.A. & O'Connor, K.M. (2010). *TIMSS 1999 International Mathematics Report. Boston*:

International Study Center, Boston College Press.

Mutambara, L.H.N., Tendere, J., & Chagwiza, C.J. (2020). Exploring the conceptual understanding of the quadratic function concept in teachers' colleges in Zimbabwe, in *EURASIA Journal of Mathematics, Science and Technology Education*, 16(2). pp. 18-36. https://doi.org/10.29333/ejmste/112617

National Council of Teachers of Mathematics (NCTM). (2020). *Standards for the Preparation of Secondary Mathematics Teachers*. Reston, VA: NCTM.

Opper, I.M. (2019). Understanding teachers' impact on student achievement, in *California Rand Corporation*. California, California University Press.

Özaltun, C. & Bukova, G. (2019). An instructional sequence triggering students' quantitative reasoning during learning of quadratic functions, in *Turkish Journal of Computer & Mathematics Education*, 10(1). pp. 157-194. https://doi.org/10.16949/ turkbilmat.446403.

Peel, K.L. (2020). *Professional dialogue in researcher- teacher collaborations: exploring practices for effective student learning*. Queensland, University of Southern Queensland Press.

Reynolds, A.J. & Walberg, H.L. (2012). A Process Model of Mathematics Achievement and Attitude, in *Journal for Research in Mathematics Education*.

Robitaille, D.F. & Garden, R.A. (2009). *The IEA Study of Mathematics II: Context and Outcomes of School Mathematics.* New York: Pergamon Press.

Romberg, T. (2010). Changing the Teaching and Learning of Mathematics, in *AMT*, 56(4). pp. 6-26.

Ruli, R.M., Priatna, N., Sufyani, P. & Endang, M. (2018). Analysis learning obstacle on quadratic function topic, in *International Journal of Information and Education Technology*, 8(9). pp. 681-684. https://doi.org/10.18178/ijiet.2018.8.9.1122

Samanian, S. & Roohani, A. (2018). The impact of self – regulatory strategy development on learners' descriptive writing and reflective thinking research, in *English Language Pedagogy*, 6. pp. 95-116.

Schneider, M. & Stern, E. (2008). *Conceptual and procedural knowledge of mathematics problem: their measurement and their causal interrelations. Max Planck Institute for Human Development: Germany schools*. London: Routledge Falmer.

Schoenfeld, A. (2008). Exploration of Learner's Mathematical Beliefs and Behaviour, in *Journal for Research in Mathematics Education,* 20(4):338-355.

Setati, M. (2009). Research on Multilingualism in Mathematics Education in South Africa, in *African Journal of Research in MST Education,* Special Issue 2009. pp. 65-80.

Silver, E.A, Mesa, V.M., Morris, K.A.; Star, J.R. & Benken, B.M. (2009). Teaching mathematics for understanding: an analysis of lessons submitted by teachers seeking NBPTS Certification, in *American Educational Research Journal,* 46(2). pp. 501-531.

Sorensen, N. (2021). *Exploring teacher recruitment and retention: contextual challenges from international perspectives*. London: Routledge Books.

Sorensen, R. (2013). Effective Teaching in High School Mathematics, in *Teachers and Teaching*, 12(5). pp. 312-335.

Star, J.R. (2015). Reconceptualising Conceptual Knowledge, in *Journal for Research in Mathematics Education.* 36(5). pp. 404-411.

Sunbul, Z. A. & Gordesli, M.A. (2021). Psychological capital and job satisfaction in public – school teacher: the mediating role of prosocial behaviours.

Thekwane, B.K. (2011). A Guide to the Teaching of Learner-centred Mathematics, in *Journal for Educational Reform in Namibia,* 14. pp. 1-11.

TIMSS. (2007). *The Trends in International Mathematics and Science Study.* http://timss.bc.edu/timss1 995i/t95 _study.html. Retrieved July 26, 2020.

Tsanwani, A.R. (2009). *Tracing Factors that Facilitate Achievement in Mathematics in Traditionally Disadvantaged Secondary School*s. Pretoria: Juta Books.

Yusof, Y. M. & Zakaria, E. (2010). Investigating secondary mathematics teachers' pedagogical content knowledge: a case study, in *Journal of Education and Sociology,* 2. pp. 32 -39.

Zakaria, E. & Zaini, E. (2009). Conceptual and procedural knowledge of rational numbers in trainee teachers. *European Journal of Social Sciences,* 9(2). pp. 202-217.

Zakaria, E. (2010). Analysis of Learners' errors in learning of quadratic equations, in *International Education Studies.* 3(3). pp. 105-110.

Zaslavsky, O. (2017). Conceptual obstacles in the learning of quadratic functions, in *Focus on Learning Problems in Mathematics,* 19(1). pp. 20- 44.

Zerpa, C., Kajender, A. & Van Barneveld, C. (2009). Factors that impact pre-service teachers' growth in conceptual mathematical knowledge during a mathematics methods course, in *International Electronic Journal of Mathematics Education*, 4(2). pp. 57-76.

APPENDICES

APPENDIX A: QUESTIONNAIRES

TEACHING QUADRATIC FUNCTIONS GRADE 11 MATHEMATICS IN QUESTIONNAIRE

SECTION A: BIOGRAPHICAL INFORMATION

Gender of the respondents

Male	1
Female	2

Age distribution

21-30 years	1
31-40 years	2
41-50 years	3
51-60 years	4
61 years and older	5

Academic qualification

Matric/Grade 12	**1**
First Degree	**2**
Honours Degree	**3**
Masters Degree	**4**
Doctor's Degree	**5**

Professional qualification

Diploma	**1**
Certificate	**2**
Professional Degree	**3**

What is the enrolment at your school?

1 to 200 learners	1
201 to 400 learners	2
401 to 600 learners	3
601 to 800 learners	4
801 learners and more	5

SECTION B: Level of quadratic problem solving teaching skills displayed by teachers in teaching Quadratic questions in Luvuvhu circuit

	Strongly agree	Agree	Neutral	disagree	Strongly disagree
I am competent in teaching Quadratic Function to Grade 11 learners	**1**	**2**	**3**	**4**	**5**
I can select appropriate teaching resources which improve my teaching strategies for a mathematics lesson	**1**	**2**	**3**	**4**	**5**
I can manage self invention of problem solutions by building on learners' informal knowledge	**1**	**2**	**3**	**4**	**5**
I can use a variety of approaches to teach a Quadratic Function concepts which promote learning	**1**	**2**	**3**	**4**	**5**
I use the text book quite often during my lessons in Quadratic Function periods	**1**	**2**	**3**	**4**	**5**
The school is well resourced in the teaching and learning of Quadratic Function	**1**	**2**	**3**	**4**	**5**
Teachers have not adequate training related to the implementation of the curriculum	**1**	**2**	**3**	**4**	**5**
Mathematics teachers have sufficient Quadratic Function understanding to teach the subject effectively	**1**	**2**	**3**	**4**	**5**
Teacher attitude towards Quadratic Function contributes to learners' performance	**1**	**2**	**3**	**4**	**5**
Leaners are given more time on the task to master Quadratic Function skills	**1**	**2**	**3**	**4**	**5**

SECTION C: FACTORS THAT FACILITATE LEARNER PERFORMANCE

	Strongly agree	Agree	Neutral	disagree	Strongly disagree
The learning environment is conducive to learning Mathematics	**1**	**2**	**3**	**4**	**5**
Schools in rural areas perform better in Mathematics than those in the city	**1**	**2**	**3**	**4**	**5**
Class size contributes to the performance of the learner in Mathematics	**1**	**2**	**3**	**4**	**5**
Your school is well resourced in the teaching and learning of Quadratic Function	**1**	**2**	**3**	**4**	**5**
Curriculum changes affect the learners' performance in Quadratic Function	**1**	**2**	**3**	**4**	**5**
Culture contributes to learner performance in Quadratic Function	**1**	**2**	**3**	**4**	**5**
The foundation of learners in Mathematics in primary school affects learners' performance	**1**	**2**	**3**	**4**	**5**
Learning and teaching media makes teaching and learning of Quadratic Function easier.	**1**	**2**	**3**	**4**	**5**
Attitude contributes to performance in Quadratic Function	**1**	**2**	**3**	**4**	**5**
Boys perform better than girls in Quadratic Function	**1**	**2**	**3**	**4**	**5**
Peer pressure affects performance in Quadratic Function	**1**	**2**	**3**	**4**	**5**

Interest in Quadratic Function improves learners' performance in Quadratic Function	**1**	**2**	**3**	**4**	**5**
You enjoy teaching and learning of Quadratic Function	**1**	**2**	**3**	**4**	**5**
Teaching of Quadratic Function contributes to learners' performance	**1**	**2**	**3**	**4**	**5**
Memorization helps in the learning and teaching of Quadratic Function	**1**	**2**	**3**	**4**	**5**
Psychological impact of the topic Quadratic Function contributes to learner performance	**1**	**2**	**3**	**4**	**5**
Learners do solve Quadratic Function problems at home because there is somebody to guide them	**1**	**2**	**3**	**4**	**5**
Learners have mathematical instruments for drawings in Quadratic Function	**1**	**2**	**3**	**4**	**5**
The use of television in the teaching of Mathematics affects learners' performance	**1**	**2**	**3**	**4**	**5**
Saturday's or/and Winter school affect learner performance in Quadratic Function	**1**	**2**	**3**	**4**	**5**
Teacher attitude towards Quadratic Function contributes to learners' performance	**1**	**2**	**3**	**4**	**5**
The teacher is competent to teach Quadratic Function	**1**	**2**	**3**	**4**	**5**
The teacher is knowledgeable in Quadratic Function	**1**	**2**	**3**	**4**	**5**
Extra support from the teacher affects learners' performance in Quadratic Function	**1**	**2**	**3**	**4**	**5**

SECTION D: STRATEGIES TO ENHANCE TEACHING AND LEARNING QUADRATICL FUNCTION

	Strongly agree	Agree	Neutral	disagree	Strongly disagree
Instructional materials are adequate to teach Quadratic Function	**1**	**2**	**3**	**4**	**5**
Quadratic Function topics in schools are related to real life situations	**1**	**2**	**3**	**4**	**5**
Frequent monitoring should improve learner performance	**1**	**2**	**3**	**4**	**5**
Frequent helpful feedback can improve learners' performance	**1**	**2**	**3**	**4**	**5**
Spending more time on the task should help the learner master Quadratic Function skills	**1**	**2**	**3**	**4**	**5**
The learning environment should be made conducive for effective teaching/learning to take place	**1**	**2**	**3**	**4**	**5**
Learners should be given extra-hard work to improve on their foundation	**1**	**2**	**3**	**4**	**5**
Learners should be more involved in practical work than theoretical work	**1**	**2**	**3**	**4**	**5**
Parents should buy the necessary learning instructional materials for their learners/children in school	**1**	**2**	**3**	**4**	**5**
Learners should be willing to learn on their own	**1**	**2**	**3**	**4**	**5**
Working in groups can improve learners' performance in Quadratic Function	**1**	**2**	**3**	**4**	**5**

APPENDIX B: INFORMED CONSENT

INFORMED CONSENT

I..on this day of..................2019 hereby consent to:

Being examined on the topic: **"CHALLENGES FACING TEACHERS IN TEACHING QUADRATIC FUNCTIONS IN GRADE 11 MATHEMATICS AT LUVUVHU CIRCUIT SCHOOLS".** Follow-up interview if necessary

1. The use of data derived from these interviews by the interviewer in a research report as she deems appropriate
2. I also understand that;

- I am free to end or to recall my consent to participate in this research at any time.
- Information given up to this point of participation could however still be used by the researcher.
- Anonymity is granted by the researcher, and the data will under no circumstances be reported in a manner that will reveal my identity.
- I may refrain from answering questions should I see an invasion of my privacy.
- I will be given an original copy of the agreement.

Interviewee	Interviewer	Date
....	....	....

APPENDIX C: ETHICAL CLEARANCE CERTIFICATE

UNIVERSITY OF ZULULAND
RESEARCH ETHICS COMMITTEE
(Reg No: UZREC 171110-030)

RESEARCH & INNOVATION
Website: http://www.unizulu.ac.za
Private Bag X1001
KwaDlangezwa 3886
Tel: 035 902 6731
Fax: 035 902 6222
Email: DlelanaM@unizulu.ac.za

ETHICAL CLEARANCE CERTIFICATE

Certificate Number	**UZREC 171110-030 PGM 2018/612**						
Project Title	**CHALLENGES FACING TEACHERS IN TEACHING QUADRATIC FUNCTIONS IN GRADE 11 MATHEMATICS AT LUVUVHU CIRCUIT SCHOOLS**						
Principal Researcher/ Investigator	T.O Netshifhefhe						
Supervisor and Co-supervisor	Prof AP Kutame			Mr T Talasi, Mr T Mokoma			
Department	Education						
Faculty	Education						
Type of Risk	Med Risk – Data collection from people						
Nature of Project	Honours/4th Year		Master's	x	Doctoral		Departmental

The University of Zululand's Research Ethics Committee (UZREC) hereby gives ethical approval in respect of the undertakings contained in the above-mentioned project. The Researcher may therefore commence with data collection as from the date of this Certificate, using the certificate number indicated above.

Special conditions:

(1) This certificate is valid for 1 year from the date of issue.
(2) Principal researcher must provide an annual report to the UZREC in the prescribed format [due date-18 July 2020]
(3) Principal researcher must submit a report at the end of project in respect of ethical compliance.
(4) The UZREC must be informed immediately of any material change in the conditions or undertakings mentioned in the documents that were presented to the meeting.

The UZREC wishes the researcher well in conducting research.

CHAIRPERSON
UNIVERSITY OF ZULULAND RESEAR
ETHICS COMMITTEE (UZREC)
REG NO: UZREC 171110-30
19 -07- 2019
RESEARCH & INNOVATION OFFIC

Professor Gideon De Wet
Chairperson: University Research Ethics Committee
Deputy Vice-Chancellor: Research & Innovation
19 July 2019

APPENDIX D: REQUEST TO CONDUCT RESEARCH

Enq. Netshifhefhe T.O
Cell: 072 745 7313
Email: netshifhefheto@gmail.com

P.O. Box 3145
Sibasa
0970
17 July 2018

District Director
Vhembe East District
Private Bag X 2250
Sibasa
0970

Dear Sir/Madam

REQUEST TO CONDUCT RESEARCH

I am a Masters student at the University of Zululand and engaged in a research project in secondary schools of Luvuvhu circuit in the Vhembe East District. My research study is entitled: "CHALLENGES FACING TEACHERS IN TEACHING QUADRATIC FUNCTIONS IN GRADE 11 MATHEMATICS AT LUVUVHU CIRCUIT SCHOOLS". The aim of my research is to investigate teacher challenges in the teaching quadratic functions in mathematics at secondary schools of Luvuvhu circuit in Vhembe district. I therefore request permission to conduct this research. You are further assured that data collected during the investigation will be highly confidential and will only be used for the purpose of my research.

For further information about this study, please contact my supervisor, Prof Kutame A, at this number: (072) 056 3658.

Thanking you in anticipation.

Yours Faithfully

....

Netshifhefhe TO

APPENDIX E: PERMISSION TO CONDUCT RESEARCH

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION
VHEMBE DISTRICT
2018 -09- 20
PRIVATE BAG X 2250 SIBASA 0970
TEL: 015 962 1313/4 FAX: 015 962 6039
LIMPOPO PROVINCE

DEPARTMENT OF
EDUCATION
VHEMBE DISTRICT

REF: 12/1/10/8 **ENQ : MATIBE M.S** **CONTACT : 082 300 4774**

NETSHIFHEFHE T.O

P.O.BOX 3145

SIBASA

0970

PERMISSION TO CONDUCT RESEARCH

1. The above matter refers

2. This serves to inform you that your request for permission to conduct research on the topic "*CHALLENGES FACING TEACHERS IN TEACHING QUADRATIC FUNCTIONS IN GRADE 11 MATHEMATICS AT LUVUVHU CIRCUIT*." has been granted.

3. You are expected to ensure that your interactions with teachers does not interfere with teaching and learning activities.

4. Kindly inform the Circuit Managers and principals of selected schools prior to your interactions with your research subjects.

5. Wishing you the best on your study.

DISTRICT DIRECTOR **DATE** 2018/09/20

Thohoyandou Government Building, Old Parliament, Block D, Private Bag X2250, SIBASA, 0970
Tel: (015) 962 1313 or (015) 962 1331, Fax: (015) 962 6039 or (015) 962 2288

The heartland of southern Africa - development is about people!

APPENDIX F: PROFESSIONAL EDITORS CERTIFICATE

CROCODILE LANGUAGE EDITING AND PROOF □□□□□□ READING

MISTAKES AFFECT THE QUALITY OF YOUR WORK. WE CORRECT THEM TO ENHANCE IT, ACADEMICALLY SO.

10 December, 2021.

To whom it may concern,

This is to confirm that I did proofread and edit Mr. NETSHIFHEFHE, T.O.'s Master's dissertation whose title reads: ***CHALLENGES FACING TEACHERS IN TEACHING QUADRATIC FUNCTIONS IN***

GRADE 11 MATHEMATICS AT LUVUVHU CIRCUIT SCHOOLS. His dissertation read fairly well. Errors attended to included but were not limited to concordance, some repetitions, sentence construction as well as discourse markers. After attending to these errors, Mr. Netshifhefhe's dissertation now reads perfectly well. **It however remains his sole responsibility to effect the changes outlined therein.**

Should you require any clarification, my contact details

follow below:Cell: 0784803023 or 0607589535

Email:
68ngwenya@gmail.
com Or:
ngwenyachris@we
bmail.co.za

Sincerely,

Ngwenya Christopher (PhD).