# EXPLORING TEACHING STRATEGIES TO IMPROVE THE PERFORMANCE OF GRADE 9 LEARNERS IN MATHEMATICS IN MKHUHLU CIRCUIT, BOHLABELA DISTRICT

by

**VENETIA SEBENZILE MTHETHWA**

Submitted in accordance with the requirements for the degree of

**MASTER OF EDUCATION WITH SPECIALIZATION IN CURRICULUM STUDIES**

at the

**University of Limpopo**

**Supervisor: Prof M.J. Themane**

**Co-supervisor: Prof K Chuene**

**2021**

**DECLARATION**

I, Venetia Sebenzile Mthethwa, declare that this dissertation titled: "**Exploring teaching strategies to improve the performance of Grade 9 learners in Mathematics in Mkhuhlu Circuit, Bohlabela District**", submitted to the University of Limpopo is my own independent work in design and execution. All sources cited or quoted have been duly acknowledged by means of complete references.

I further declare that I have not previously submitted this research report for a degree at any university. I also have not allowed, and will not allow anyone to copy my work with the intention of presenting it as his or her own work.

_____ _____

**Signature** **Date**

## DEDICATION

This study is dedicated to my loving husband David Qiniso Mthethwa, who could not wait to witness this milestone (May his soul rest in perfect peace). My children, Pretty and Portia this work belongs to you.

**ACKNOWLEDGEMENTS**

I wish to express my sincere appreciation and gratitude to the following people for their support towards the completion of this study:

The journey from the conception, development and the completion of this study could have been a nightmare had it not been for my supervisor, Prof. M.J. Themane for his encouragement, tireless support, guidance and inspiring energy throughout. Thank you, Prof, you are deeply admired and respected.

I also give special thanks to my children, Pretty and Portia for their sacrifice, support and understanding.

My sisters, Neah and Witness for always being there for me throughout; your encouragement and follow-up inquiries on my progress pushed me this far. Thank you so much. You have been a significant source of support and I am deeply indebted to you for the completion of this exacting journey.

To all my friends, relatives, and all the people who took part in my study for their moral support. To all of them I say: “You are benefactors of this product”.

Above all, I give all the glory, honour and praise to *Elshadai Adonai* for the provision of all that I needed to complete this study.

## ACRONYMS AND TERMS USED IN THIS STUDY

| | |
|---|---|
| ANA | Annual National Assessment |
| ES | Education Specialist |
| SMT | School Management Team |
| SGB | School Governing Body |
| SA | Subject Advisor |
| GET | General Education and Training |
| TIMSS | Trends in International Mathematics and Science Study |
| PISA | Programme for International Student Assessment |
| SACMEQ | Southern Africa Consortium for Monitoring Education Quality |
| LTSM | Learning and Teaching Support Material |
| DBE | Department of Basic Education |
| NPPPR | National Policy on Promotion and Progression Requirements |
| CAPS | Curriculum and Assessment Policy Statement |
| ICT | Information and Communication Technology |
| MST | Mathematics, Science and Technology |
| PCA | Provincial Common Assessment |
| LPIP | Learner Performance Improvement Plan |
| NDP | National Development Plan |
| DDD | Data Driven Dashboard |

**ABSTRACT**

This study explored the different teaching strategies which teachers use to teach mathematics in order to improve the performance of Grade 9 learners in the subject in Mkhuhlu Circuit; Bohlabela District of Education in Mpumalanga Province. The inability of Grade 9 learners to achieve the set minimum performance standard of a pass at level 3 (40%) in mathematics poses a challenge because mathematics is set as a pass requirement in the said grade and it is compulsory for all learners to enrol for this subject. The poor performance of learners in mathematics is attributed to inappropriate teaching strategies that teachers use in the teaching of this subject. There are lessons to be drawn from the practices of leading countries in learner performance in mathematics and this study sought to find alternative strategies that are appropriate for teaching Grade 9 learners and to improve their performance in mathematics in the circuit.

The study used constructivism as its lens to look at the realities about learner performance in mathematics. Constructivism as a theory presents and unpacks the manner in which people learn and acquire knowledge. The participants for this study were sampled using a purposive sampling technique and samples were drawn from two secondary schools representing good and poor performance of Grade 9 learners in mathematics. Seven participants were engaged in this study and this sample included a principal, SMT member, and mathematics teacher from each school. A subject advisor for mathematics in the GET was also interviewed. This study adopted and followed a qualitative design of inquiry which included interviews, observation, and the analysis of documents and artefacts to collect data from the different respondents that were identified for this study. The inquiry was guided by the following research questions:

Which teaching strategies do teachers normally use to teach mathematics in Grade 9 at Mkhuhlu circuit?

There are two sub-questions which were used to support the main research question and they are:

To what extent do teachers vary the strategies of teaching and which strategies and LTSM do the teachers use to teach mathematics in Grade 9?

What is the level of support that teachers receive from the different levels of the system? Data was analysed by organizing the data collected using codes to

summarize it and then interpret the coded data to identify themes, patterns and relationships. This study revealed that different teaching strategies have an impact on the learners' academic performance in mathematics. It also emerged from this study that quality and effective teaching and learning of mathematics are grounded on the constructivist theory. This study also established that the choice and use of appropriate teaching strategies coupled with the availability of relevant resources contribute towards positive learning gains. Similarly, learners' preferences of teaching and learning strategies must be considered towards the development and sustenance of a positive attitude towards mathematics.

The study recommended that the Annual Teaching Plans should suggest teaching strategies to be used for a particular topic; and that teachers must specify their teaching strategies and their choice of resources in the planning of every lesson. The provision of resources, particularly for mathematics teaching must be made an apex priority. Subject advisors must give attention to the teaching strategies that teachers use in curriculum delivery and not only on content mastery and coverage. School Management Teams must follow-up on the implementation of ICT in their curriculum management and monitoring. The study further recommended that an analysis of results must shift from concentrating on the pass percentages and focus on the quality of the passes. The identified limitations of this study were methodological limitations and sample characteristic limitations where the size of the research sample was relatively small.

## TABLE OF CONTENTS

# CHAPTER 1

# ORIENTATION TO THE STUDY

## 1.1 INTRODUCTION AND BACKGROUND TO THE STUDY

Despite the fact that mathematics is a compulsory subject and a requirement for promotion in the General Education and Training (GET) band, performance in this subject in South Africa, particularly in Grade 9 remains dismal and a disconcerting matter (Olorunfemi, Olawumi & Adu, 2018; NPPPPR, Government Gazette, 2012). Learners find it difficult to meet the set minimum performance benchmark of level 3 (40%). The plan, according to the national vision for 2030 is to have 80% of learners performing at 50% (level 4) and above in literacy, mathematics and science (National Planning Commission, 2011). However, a large percentage of Grade 9 learners have not yet achieved a minimum competency level in mathematics and science (Zuze L. , Reddy, Visser, Winnaar, & Govender, 2017). This poor performance in mathematics is prevalent in spite of all policy interventions to uplift and strengthen sciences in the country (Sinyosi, 2015).

Results of the national and international assessments such as Trends in International Mathematics and Science Study (TIMSS), Programme for International Student Assessment (PISA), Southern Africa Consortium for Monitoring Education Quality (SACMEQ), the Annual National Assessments (ANA), and the National Senior Certificate (NSC) exams, confirm that the underachievement by the majority of South African learners in mathematics (Poutnara, Hodgen, Adler & Pillay, 2015). Zuze et al (2017) report that only a third of Grade 9 learners performed at the set minimum competency level in the 2015 TIMSS assessment in South Africa. This challenge of underperformance in mathematics is exacerbated by the grade (Mutodi & Ngirande, 2014) promotion of learners who are not yet ready in the senior phase (National Planning Commission, 2011). Poutnara et al, (2015) further argued that there is no significant progress in the improvement of learners' performance in mathematics because all endeavours to improve learner performance in the subject were directed towards mathematics teachers' professional development.

Underperformance in mathematics is not a challenge for South Africa only, but it is also prevalent in other African countries like Zimbabwe (Mupa, 2015), Kenya (Simba, Agak & Kabuka, 2016) and Nigeria (Omenka & Otor, 2015). These scholars further argued that there is a downward trajectory in mathematics performance to undesirable levels as learners proceed with grades. This trend of decline in mathematics performance as learners proceed with grades was observed in South Africa (Hagoramagara, 2015). Poor performance in mathematics is also a challenge even in developed countries like Greece (Karakolidis, Pitsia & Emvalotis, 2016). These scholars reported that more than 35% of learners fail to meet the minimum proficiency level 2 which is 24, 2% in mathematics.

Poor performance in mathematics across all grades is a disconcerting issue because it is a compulsory subject from Grade 1 to Grade 9. It is disheartening when learners struggle in mathematics because it is the most important subject in the curriculum (Sa'ad, Adamu & Sadiq, 2014). Its indispensability resides in the fact that it is the corner stone for development as it prepares learners for their future irrespective of their career choices (Davies & Hersch, 2012); (Salami & Okeke, 2017). Mathematics helps to develop mental processes that enhance logical and critical thinking, accuracy and problem solving as well as decision-making (Department of Education, 2012), and it is also crucial for socializing in public life (Ayal, Kusuma, Sabandar & Dahlan, 2016).

In light of its importance presented above, it is disquieting when learners struggle to master the prescribed curriculum content as it has a potential to bring doom to the future of the country. In pursuance of a panacea for the poor performance, literature among other factors, points to the teachers' weak subject content knowledge in mathematics (Poutnara, et al, 2015); lack of competence to deliver quality classroom instruction (Ogbeba ,2010); content gaps as learners move through grades (Spaull & Kotze, 2015); learners' attitude towards the subject (Olurenfemi, Olawumi & Adu, 2018), and inadequate textbooks and personnel (Adu, Adu & Chikungwa, 2017) as contributory to this undesirable state of performance.

In an attempt to unravel the problem of underperformance in mathematics, a review study was conducted by Umalusi to develop an understanding of the strengths and weaknesses of the subject curriculum. The outcomes of the review revealed that though the subject curriculum was precise on the content per grade, it was however silent with regard to the choice of teaching strategies to be employed in teaching it (Grussendorff & Booyse, 2014). Due to the mismatch between the curriculum content and the appropriate strategies to teach it, the education system is left dependent on the teachers' choice of teaching strategies for the delivery of quality mathematics lessons. This is a problem which affects the productivity of lessons delivered. The shortage of appropriate teaching strategies in mathematics is the major challenge confronting classroom teaching (Bature & Jibrin, 2015); Carolina, et al, 2016).

It is indispensable that in order to catch down a viable solution for improved performance in mathematics, what happens within the allocated teaching period in class should be looked into. The teachers' presence in class, qualification and the availability of Learning and Teaching Support Material (LTSM) may not translate into quality teaching and learning unless the teacher employs an appropriate teaching strategy. The choice of an appropriate and specific teaching strategy is pivotal for the enhancement of learners' understanding in mathematics. I am in support of the postulation by Enriquez, de Oliveira and Valencia (2018) that there is a need to reflect on the teaching strategies utilized in order to improve performance because a strategy propels and clarifies the lesson outcomes.

Ayodele in Bature and Jibrin (2015) opined that non-effective and inappropriate teaching strategies, particularly the teacher- chalk and lecturing teaching approaches were the bedrock of poor performance in Nigerian schools. Based on Ayodele's assertion and the recommendation for further study about teaching strategies that can improve learner performance in mathematics in South Africa by Sinyosi (2015), this study sought to explore teaching strategies that Grade 9 mathematics teachers employ in Mkhuhlu circuit. Looking into the practices of leading countries in mathematics performance, the study sets out to find alternative strategies that are appropriate for teaching Grade 9 learners and to improve their performance in mathematics in the circuit (Borg, Hewitt, & Jones, 2016; Bada & Olusegun, 2015; Powell & Kalina, 2009).

## 1.2 PROBLEM STATEMENT

There is evidence that shows a decline in mathematics performance for Grade 9 learners in South Africa. The 2014 Annual National Assessment (ANA) report revealed that the national averages in mathematics from 2012 to 2014 were 13, 12 and 11 respectively. The report further clarified that a majority of Grade 9 learners performed at level 1 which is a performance below 20% in the 2014 ANA (DBE, 2014). Olurenfemi, Olawumi and Adu, (2018) lament that underperformance in mathematics poses a serious challenge given that it is a compulsory subject in the General Education and Training (GET) band. Furthermore, a pass in mathematics is set as a minimum requirement for promotion to the next grade (NPPPR, Government Gazette, 2012).

This study problematizes the inability of Grade 9 learners to achieve the set minimum performance standard of a pass at level 3 (40%) in mathematics, which can be attributed to inappropriate teaching strategies that mathematics teachers use in the teaching of this subject. A similar pattern has been observed in Zimbabwe where, despite the fact that it is a compulsory subject, levels of learners' achievement in mathematics continue to be a disconcerting national issue (Makamure, 2018). Dealing with the problem of underperformance in mathematics appears almost impossible as traces of underperformance are also noticed even in highly performing education systems like Taiwan (Lee & Seah, 2015).

Findings of studies conducted worldwide to curb the poor performance of learners in mathematics point to numerous factors behind this problem. Among others, teachers' inadequate subject content knowledge and lack of skills to transmit what they know to their learners (Spaull, 2015; Stols, Ferreira, Pelser, Oliver, Van der Merwe, De Villiers & Venter, 2018); learners' attitude due to their marginal proficiency of the language of learning and teaching (Olurenfemi, Olawumi & Adu, 2018), and inadequate resources (Adu, Adu & Chikungwa, 2017), have been identified. The Curriculum and Assessment Policy Statement (CAPS) is silent on the choice of strategies for teaching mathematics such that teachers adopt strategies that they are comfortable with. These strategies however, may not be suitable for the particular content that needs to be taught and it for this reason that there is a need

for a review of these strategies. Based on the gap identified above, Sinyosi (2015) argues that for better performance in mathematics, teaching strategies should be reviewed and monitored. Therefore, this study seeks to explore teaching strategies used by Grade 9 mathematics teachers in an attempt to discover alternative appropriate strategies per content for the improvement of learner performance in mathematics with particular focus on Mkhuhlu circuit.

## 1.3 AIM AND OBJECTIVES OF THE STUDY

### 1.3.1 Aim(s) of the study

This qualitative case study sought to explore the different teaching strategies that are available to mathematics teachers for teaching mathematics in Grade 9 at Mkhuhlu Circuit, Bohlabela District in Mpumalanga.

### 1.3.2 Objectives of the study

The objectives of this study are the following:

- To identify teaching strategies that Grade 9 mathematics normally use to teach mathematics at Mkhuhlu circuit and to measure the effectiveness of these teaching strategies;
- To investigate the availability and utilization of LTSM and other resources that are appropriate for teaching mathematics; and
- To establish the type of support that mathematics teachers receive from the different levels of the department of education with regard to planning, instruction and assessment in Grade 9.

## THEORETICAL FRAMEWORK

This study is based on constructivism as its theoretical framework. Constructivism is a theory of learning found in psychology which presents and unpacks the manner in which people learn and acquire knowledge, and its historical stance can be traced in the works of theorists like Dewey (1929), Bruner (1961), Vygotsky (1962), Piaget (1980) and von Glasersfeld (1995) (Bada & Olusegun, 2015).

Piaget's contribution to constructivism is his two-pronged theory which includes "ages and stages" and the "theory of development" (Amineh & Asl, 2015). Piaget (1977) posits that learning occurs through an active construction of knowledge, rather than through passive reception (Amineh & Asl, 2015). His tenet of how

learners learn presents that when learners come across a situation that is inconsistent with their current way of thinking, a state of imbalance or disequilibrium is created. The state of balance or equilibrium is restored by changing the way learners think to make sense of the novel information by associating it with what they already know (assimilation). Again, when the learners fail to assimilate the new information, they lodge it to their old way of thinking (accommodation) by restructuring their present knowledge to a higher level of thinking (Gray, 1997). This constructivist view of learning claims that learners construct new meaning through their existing knowledge, which implies that pre-existing knowledge, influences the novel knowledge. Piaget's theory emphasizes that learning is not a passive phenomenon, instead it is an active operation whereby learners negotiate their understanding with what they experience in their learning situation (Amineh & Asl, 2015). This theory advocates active participation of learners in the learning process and that teachers should build on what their learners already know when they introduce new concepts.

The centre of attention of Piaget's constructivism is basically on an individual, particularly on how the individual constructs their knowledge. Based on Piaget's theory of cognitive or individual constructivism, it is proposed that humans are not passive recipients of information for understanding and utilization, but individuals engage in a personal process to construct their own knowledge and understanding (Powell & Kalina, 2009). The two scholars further dissect the two processes that an individual engages in when constructing their knowledge; which is assimilation and accommodation. Assimilation is when children bring in new knowledge to their own mental synopsis or schemas and accommodation is when children have to change their schemas to let in or "accommodate" the new information or knowledge. In learning, there is an adaptation process that occurs as one refines novel information to connect it with the already existing mental framework. In cognitive constructivism, it becomes imperative to create a learning environment and design activities that would involve learners for the advancement of individual learning. Constructivist teaching and learning requires that teachers should facilitate knowledge construction as an individual process within the learning environment. It is also important for teachers to recognise that this process of knowledge construction happens to learners in different rates or paces. Piaget's cognitive constructivism theory

highlights the importance of realizing that each individual needs to acquire knowledge and learn at their own pace.

Alongside Piaget's theory is Bruner's theory which asserts that learning is a social process in which learners construct new concepts and understanding based on their existing knowledge (Amineh & Asl, 2015). The learners select information, predict and make decisions in order to integrate new encounters to their existing experience and knowledge. Bruner advocates learner independence for making new discoveries as the cornerstone for effective learning. Bruner's theory suggests that learning content should be designed in a spiral mode to enable learners to use their existing knowledge as the foundation to construct new knowledge (Amineh & Asl, 2015). This theory, therefore, emphasizes the importance of prior knowledge as the basis of learning.

The tenet of Ernest von Glaserfeld's constructivism as a theory of learning advocates the following two principles: firstly, that knowledge is not passively received but actively built up by the cognizing subject; and secondly that the function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality" (Glaserfeld, 1989). Based on von Glaserfeld's postulation, the constructivist approach to teaching and learning is that the learners are active participants in the learning process (Fernando & Marikar, 2017). This implies that teachers should consider that when they plan their lessons and particularly on their choices of teaching strategies. Teachers should therefore link their teaching to the constructivist theory to ensure that learners are not limited to being passive knowledge recipients due to the choice of inappropriate strategies and teaching practices.

Alongside cognitive constructivism, social constructivism advocates that ideas and knowledge construction is the result of human interactions. Learners learn through interacting with their teachers and fellow learners. Powell and Kalina (2009) opine that Lev Vygotsky, the founder of social constructivism believed in social interaction and language development as the anchor of learning. Lev Vygotsky's contribution to constructivism is based on his theory about language, thoughts and their interrelation in society (Amineh & Asl, 2015). Vygotsky believed that community plays a major role in the process of knowledge construction, a and the environment in which

children are brought n influences how they think and what they think about (McLeod, 2019). Cognitive development is regarded as a product of a human interaction with external factors such as society, history and culture through language (Amineh & Asl, 2015). Knowledge development based on Vygotsky's theory is triggered by social interactions within the zone of proximal development as children and their partners co-construct knowledge guided by their teachers (McLeod, 2019).

Social constructivism incorporates collaboration and social interactions and is therefore regarded as an effective teaching method and beneficial to all learners. Based on social constructivism, teachers should create learning environments that would encourage and promote interaction and collaboration among learners. An effective learning environment fosters communication and processes that would trigger critical thinking. It therefore suggests that teachers should allow learners opportunities to learn from others through group discussions and activities that would promote collaboration.

In support of Vygotsky's theory, John Dewey's contribution to constructivism is that he believed that learning is a social activity. It is something we do together and in interaction with each other (McLeod, 2019). These theories propose the choice and utilization of cooperative or collaborative teaching strategies in learning where learners would be given a platform to interact in their knowledge construction. Cooperative teaching strategies which are aligned to Vygotsky and Dewey's theories would include group-work, team-work and games; where the role of the teacher tends to be facilitation rather than lecturing.

These theorists' contribution and relevance to constructivism as a teaching and learning theory is founded on an important educational thought that teachers cannot just transmit knowledge to learners but that in learning, learners have to engage actively to construct meaning in their own minds. The constructivist view of learning regards learners to be active agents in the process of harvesting knowledge rather than passive recipients of knowledge. This underlying belief in learning places learners at a position where they partner together with their teachers in a learning environment, sharing roles and responsibilities to build up their own comprehension (Bada & Olusegun, 2015). In the learning environment, the constructivist view of

learning may look into a number of different teaching operations. Constructivism suggests that teaching should be multifaceted and varied to meet the diverse nature of learners in a classroom (Wesonga & Aurah, Instructional Strategies and Learning Styles as Predictors of High School students' Academic Performance in Physics Prscticals in Kenya, 2019). Learners are in essence exposed and encouraged to explore active techniques like real-life problem solving and experiments for more knowledge construction and then reflect on how their understanding improves.

It is the constructivist conviction that learners learn by situating novel information within the framework of their readily existing knowledge. Basically, learners construct new understandings with the help of their pre-existing knowledge or what they knew previously. This calls for teachers to consider that learners do not come to a learning environment as clean slates. However, learners bring with them knowledge acquired from previous encounters into the learning situations. The prior knowledge of the learners influences and shapes the new knowledge they happen to construct through their new learning encounter. This means that in learning, learners come across new information and transfigure it; they again dissect new knowledge averse to the old. This core idea presents that learners build new understanding upon the base laid through knowledge acquired from previous learning (Bada & Olusegun, 2015).

Constructivists believe that learning is affected by the conditions and circumstances in which a concept is taught as well as by the learners' beliefs and attitudes (Bada & Olusegun, 2015). This implies that the culture of both learners and teachers has a bearing on the learners' acquisition of knowledge, meaning that it creates a framework in the cognitive structure of both learners and teachers. People will always attach meaning to new content in the confinement of their different cultures. Therefore, it becomes imperative for teachers to work towards establishing a link between their teaching content and their learners' culture. Teachers are called upon to create a link between the content and knowledge for their intended lesson to the experiences of their learners (Borg, et al, 2016).

Furthermore, it calls for all educational stakeholders to take their responsibility posts in ensuring that the teaching and learning environment is conducive in terms of the provision of resources to advance quality instruction. Learners should be supported

to understand mathematics by creating a learning environment that exhibits the real material learners are learning about. Learners need exposure to the real content material in the advancement of meaningful and associative learning. Learning is made meaningful when the learners are allowed an opportunity to experience what they are being taught through most of their senses. As individuals with their own minds, learners should be provided with space to be in control of their learning.

The saying that “iron sharpens iron’ becomes relevant when illustrating the expertise and attitude of teachers towards the subject they teach; in this case, mathematics. Based on Bada’s postulation that beliefs and attitude may make or break knowledge acquisition in learners, teachers are better placed to build a positive attitude and the love of mathematics within learners if they themselves are confident with and have love for the subject. The impact of the remarks teachers make about mathematics when they teach, cannot be overemphasized on the attitude learners may develop and internalize towards mathematics.

The tenet of constructivism as a learning theory is that learning should be holistically learner-centred and an opportunity should be bestowed to the learners to be actively involved and to participate in their learning. Learning is anchored and mostly dependent on the learners’ drive and motivation to participate in the lesson offered. In constructivist teaching, learners are the key role players in the process of knowledge construction.

## 1.5 RESEARCH DESIGN AND METHODOLOGY

This study employed the qualitative research methodology. The choice of qualitative research was informed by the fact that this study is concerned with the meaning people construct; how people interpret their world and the experiences they have in the world (McMillan & Schumacher, 2010). The relevance of a qualitative approach for this study is because the researcher personally collected data in the field at the site under investigation.

### 1.5.1 Research Approach

This study adopted and followed the case study design of inquiry. This was informed by the fact that Mkhuhlu circuit was chosen as a case to conduct an analysis of the teaching strategies and the learning of mathematics in Grade 9. The multiple

methods like interviews, observation, documents and artefacts analysis were employed in order to get a better understanding of how teaching strategies are employed in the teaching of mathematics in the contemporary context (McMillan, 2016).

### 1.5.2 Sampling

For a case study, sampling refers to selecting a case and selecting data sources that propel in-depth understanding of the case (Gentles, Charles, Ploeg & McKibbon, 2015). Participants in this case study were sampled using a purposive sampling technique. Samples were drawn from schools with good and poor mathematics performance in Grade 9 based on their anticipated in-depth and relevant information related to the study. The sampling quota is presented in the table below:

| **SCHOOL** | **PRINCIPAL** | **HOD's** | **TEACHERS** | **TOTAL** | 1 |
|---|---|---|---|---|---|
| **A** | 1 | 1 | 1 | 3 | SUBJECT |
| **B** | 1 | 1 | 1 | 3 | ADVISOR |
| | | | | | FOR GET BAND |
| **TOTAL** | 2 | 2 | 2 | 06 | **07** |

### 1.5.3 Data collection

Multiple methods of gathering data such as interviews, observation and documents and artefacts analysis were used to collect data from the different respondents that were identified for this study.

***Observation***

Observation as a data collection technique was instrumental in enabling me to read the non-verbal behaviours, gestures and body language (Wragg, 2013). Mathematics class visits were conducted to observe the teacher-learner interaction in class and to explore different teaching strategies used. The teachers' teaching practices as well as the utilization of teaching aids during lesson presentation were given attention. The observation also covered the classroom environment; including the extent to which the classroom was designed to be a stimulating learning centre

for mathematics which includes the use of the classroom walls for teaching aids. Observation protocols were observed during all the observation sessions.

***Interviews***

The researcher conducted unstructured and semi-structured interviews with school principals; heads of departments; teachers, and the mathematics Subject Advisor (SA) for GET. In all instances, the interviews were conducted outside working hours to avoid disrupting the participants' work programs. Comprehensive records of the participants' responses were kept, and with the participants' consent and in line with ethical research practice, a voice recorder was used during interviews to record the responses for purposes of supporting the hand-written notes of the researcher.

***Document and artefact analysis***

The last technique for data collection that was used is documents and artefacts analysis. Time was taken to look for documents that included the analysis of learner performances in the internal and common external assessments as well as teachers' profiles. Minutes of departmental meetings were part of the documents which were perused to solicit a deeper understanding of the kind of support given to mathematics teachers through meetings and departmental interactions with their Education Specialists (ES). The monitoring instruments for curriculum management and the class visit and observation tools were also instrumental to shed light on the SMT's targets and priorities for teacher development and support.

### 1.5.4 Data analysis

The process of data analysis commenced with organizing the data collected using codes to summarize it and then interpreting the coded data to identify themes, patterns and relationships (MacMillan, 2016). The interpretation and understanding of the knowledge gained through data analysis enabled the researcher to answer the research questions (Marshall & Rossman, 2011).

## 1.6 ETHICAL CONSIDERATIONS

For the purpose of ensuring ethical research practice in this study, consideration was given to the following ethical issues: voluntary participation, confidentiality and anonymity, informed consent, research integrity and ethical policy of the university. Each of the ethical issues listed above and others are explored in some detail below:

Permission to conduct the research in Mkhuhlu circuit was sought and obtained from the Mpumalanga Department of Education. A written request was handed over to principals for the involvement of their School Management Team members, teachers and learners. Participants in this study were treated with great respect and they were assured that their identities as well as their responses would be treated as confidential.

The participants were requested and encouraged to participate in the study on a voluntary basis. They were furthermore informed about their right to withdraw their participation anytime they would feel like doing so. The participants were not bribed to participate in the study and no payment in any form was promised nor given as a reward for their participation.

High level of integrity was maintained throughout the processes of the study and professionalism was observed at all times while dealing with the participants. The data that was collected was captured and used raw as it was without any form of bias or manipulation by the researcher. All the reference sources were properly acknowledged to avoid plagiarism. The researcher applied for ethical clearance from the Ethics Committee of the University of Limpopo (TREC) before the commencement of the data collection process.

## 1.7 QUALITY ASSURANCE

The researcher engaged three processes to ensure the credibility of the study as presented by Creswell (2014) in McMillan (2016).

### Triangulation

The researcher triangulated different data sources to validate the accuracy of the findings. Assertions and interpretations derived from data were critically examined to ensure that they are credible (Efron & Ravid, 2013).

**Member checking**

The researcher made a comprehensive summary of the notes at the end of the interview session to establish the accuracy of the notes and to establish whether or not they reflect the point of view of the participants. This was achieved through sharing the draft of the final research report and requesting the participants to make comments if the records were fair, reasonable, accurate and complete (McMillan, 2016).

**Peer debriefing**

The researcher involved another person for the review of the findings of the study for credibility and to ascertain whether or not the findings are connected to the data. Furthermore, the researcher ensured that the person involved was conversant with qualitative analysis and had knowledge concerning the subject matter of this study. The person was completely detached from the study so as to provide a fresh perspective (Mcmillan, 2016).

## 1.8 SIGNIFICANCE OF THE STUDY

No research will be declared complete if it lacks an element of significance. The significance of this study is linked to Sinyosi's recommendation to the Department of Education that the methods of teaching and learning in mathematics should be monitored or re-examined (Sinyosi, 2015). In support of Sinyosi's recommendation, the following points present the significance of this study:

- Outcomes of this study will assist the department and policy developers to develop subject policies that will guide teachers, School Management Teams and subject advisors to adopt and manage appropriate teaching strategies that will contribute to the improvement of the performance of learners in mathematics;
- This study has the potential to reverse the perception that mathematics is a difficult subject (Mutodi and Ngirande, 2014). This is a perception which is held even by many adults; that lack of accomplishment in mathematics is a permanent state over which they have little control (Mutodi and Ngirande, 2014) and

- The study will identify and address the challenges encountered in the teaching and learning of mathematics and equip teachers with alternative strategies that will not only contribute to the improvement of learner performance in Mathematics; but also contribute to inculcating love for the subject.

## 1.9 LIMITATIONS OF THE STUDY

The purpose of this study was to explore teaching strategies that would contribute to the improvement of the performance of Grade 9 learners in mathematics. However, like other studies, this study had its limitations too. Dimitrios and Antigoni (2019) assert that limitations of any particular study refer to possible weaknesses that are usually beyond the researcher's control; which are closely connected to the research design used. Dimitrios, et.al (2019) further emphasize that that limitations have the potential to affect the design, findings and conclusion of a study and therefore, suggest that researchers should present comprehensive acknowledgement of such limitations before they submit their work (Dimitrio & Antigoni, 2019). This study adopted a qualitative approach, thus making it explorative and descriptive in nature. Consequently, the study had methodological limitations. Given that qualitative studies are subjective in nature, the findings of this study may not reflect the reality as is because the researcher relied on the participants' opinions and honesty as well and their willingness to disclose the truth. Furthermore, as subjective analysis is the lifeblood and nature of qualitative studies, potential researcher biasness in the interpretation of data could have affected the quality and credibility of the research findings. In order to counter this limitation, the researcher used multiple data collection methods to ensure the credibility of the findings. The researcher conducted observations, and studied documents and artefacts to augment the facts raised by respondents and to discover what could not be revealed through the interviews.

Furthermore the study had sampling limitations. The sample population was drawn from only two secondary schools and participants in each school were only members of the school management team; which included only the principal, one ES, and the subject teacher. The size of the sample was relatively small to draw a plausible generalization for the entire circuit made of eleven secondary schools based on the behaviour and opinions of the sample. To address this limitation, a future study was

recommended where a larger sample population would be involved including SGB's and other stakeholders.

## 1.10 CHAPTER OUTLINE

This section outlines and describes the contents of all the chapters of this research report.

**Chapter one**

This chapter presents the introduction and background of the study. It also presents the aims and objectives of the study; statement of the problem; theoretical framework, ethical considerations and the research design and methodology adopted for the study. Furthermore, the chapter unpacks the population and sampling of the study; data collection and analysis techniques; quality assurance and limitation of the study.

**Chapter two**

This chapter presents the summary of reviewed literature and the theoretical framework of the study.

**Chapter three**

This chapter lays out the research design and methodology that was adopted and used for the purpose of the study. This chapter further presents how data was collected and analysed.

**Chapter four**

This chapter presents the main results of the study.

**Chapter five**

This chapter presents the summary of the results of the study, discussion of individual themes and implications of the results.

## 1.11 CHAPTER SUMMARY

The chapter presented the snapshot of this study by detailing the background, problem statement as well as the aim and objectives of this study. Furthermore, the

chapter outlined the research design and methodology used in this study as well as the data collection and analysis methods. The significance of the study and the ethical consideration were presented and most importantly, the chapter acknowledged the limitations of this study. The theoretical framework informed and shaped the selection of the reviewed literature which follows in the next chapter.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 INTRODUCTION

The previous chapter outlined the background, problem statement and the purpose of the study. This chapter presents a review of the literature as well as the theoretical framework on which this study is based. This chapter starts off by clarifying two concepts; 'strategy' and 'teaching strategy' as they are frequently used in this study. A comparative study of the performance of Grade 9 learners in mathematics measured by standardized assessments in the provincial, national and international spheres was conducted. The literature that was reviewed focused on the meaning and impact of teaching strategies as aligned with the theory that guided this study. Furthermore, this chapter looked into the connection between the choice of teaching strategies used by mathematics teachers and learners' performance in the subject. The last part of this chapter deals with the teaching of mathematics based on the constructivist theory of learning which clarifies the role of teachers, learners and teaching and learning support resources during lesson presentation.

## 2.2 DEFINITION OF CONCEPTS

### 2.2.1 Strategy

The etymology of the concept 'strategy' dates back to the period of 400 – 200 B.C., discussed by Chinese and later by Greeks around 330 AD (Horwath, 2006). Strategy is derived from the traditional Greek word "strategia", which means the "art of the generals" and "strategema", meaning "territories under the control of a strategus; a military commander" in ancient Athens until it revolved to "La Strategique" in 1799 to the sense it is currently understood (Owens, 2007). Strategy originated from a military background and was utilised as a concept that represented an art of assembling and employing military forces in time and space to achieve the goals of a war. However, the term 'strategy' and strategic discussion has moved beyond its etymological origin in the art of generals, and is now eminent in theories of organisations and business (Freedman, 2013; Owens, 2007). Freedman (2013)

argued that there is no single definition of strategy that has been adopted that describes the field and limits its boundaries as it has been adopted in many aspects of life, including politics and business.

Edward Mead Earle in Owens (2007) defines a strategy as the art of managing and utilizing the resources of a nation to the end that its essential interests shall be effectively promoted. Generally, a strategy refers to a combination of ideas, thoughts, goals, experience, insight, expertise, memories and perceptions that gives guidance on how to pursue the desired end (Rahayu & Siregar, 2018). Furthermore, a strategy is described as a goal setting activity which also includes determining actions to be undertaken in order to achieve the set goals as well as organising the necessary resources for the intended actions (Ocasio & Joseph, 2018). This postulation connects a strategy to resources used towards the promotion of salient interest. It implies that resources are a cornerstone of every strategy. In an organisation, the development of a strategy is based on the vision for the future and the goals of the organization as well as an evaluation of available alternatives (Owens, 2007). Furthermore, Owens (2007) described a strategy as a guide for future planning whereby the planner should firstly identify interests and the objectives necessary to achieve those interests. In military terms, Horwath (2006) asserted that a strategy developed to enable people to defeat their adversaries and it laid out the use of engagements to achieve the objectives of the war. Meanwhile, in business terms, strategy refers to what enabled a company to gain sustainable margin over its competitors (Horwath, 2006).

Classically, strategy has been concerned with political strife by states to influence their position and structure within international systems. In the present day, strategy is outlined as being concerned with the maintenance of balance between ends, ways and means (Freedman, 2013). Furthermore, Freedman (2013) adds to clarify that the balance is not only about determining how to achieving the desired end, but also adapting these ends depending on the available resources to work out a pragmatic course of action to realize the desired ends. As a means to the end, a strategy details actions to be taken in order to achieve the desired end. Strategy is not constant but dynamic, changing as the factors that influence it change (Owens, 2007). Horwath (2006) advocated the utilization of different strategies as he claims that there is no single strategy that may open up to victory over a competitor. In

support of that, Owens (2007) brought in the issue of adapting to changing conditions by strategy makers and implementers to avoid and to mitigate problems.

Therefore, it is expected that a strategy should start off by the illustration of the required end situation. A strategy is all about choice. Therefore, it is imperative to cross-check and reason around the choice for the sake of the desired end (Freedman 2013). Freedman (2017) emphatically associated strategy with the concept of power in the sense that it presented the capability to produce intended outcomes. Freedman suggested that a strategy remains an appropriate expression there is that denotes an endeavour to visualise actions in advance; considering our goals and capacities. Furthermore, a strategy is about the identification of objectives and organizing resources and available methods to realize such objectives (Freedman, 2013). Owens (2007) asserts that a practical strategy must take into consideration such factors as the availability of resources, technology and geopolitical realities. This means that there are aspects to be considered in the design and choice of a strategy; including a thorough study of the area for which it is intended as well as access to necessary resources for it to be viable.

Based on a myriad of definitions, ideas and arguments around the concept of 'strategy' presented by the different scholars above, a strategy is understood as a phenomenon of goal setting using ideas; thoughts; past experience and expertise; insight and perceptions to design an aspired end in institutions. It involves development of feasible and practical objectives; considering available resources as one of the means to the desired outcome. Strategy is that which enables an organisation to stand out, outshine and outperform its competitors in its territory of operation. It is also is deduced from the reviewed literature that the success of a strategy is anchored on the consideration of factors such as geopolitics and access to resources within the environment it is intended for. Looking into resources, it was advocated that a strategy should incorporate technology for it to be effective. Again, it was clarified that variation of strategies is beneficial as there is no single strategy that can lead to the desired end and that adaptability to changing conditions is an added advantage for the developers and implementers of a strategy. As it was indicated that the concept of 'strategy' grew to be used in diverse situations, for the purpose of this study, the focus will be on teaching strategies.

### 2.2.2 Teaching Strategy

Definitions of teaching strategies vary in the literature; they are at times referred to as ‘teaching methods’, ‘approaches’, ‘techniques’, ‘styles’, ‘ways’, or ‘practices’ (Cohenmiller, Merril, & Shamatov, 2018). Breaking down the generic explanation of a strategy given above and narrowing it into the focus of this study, Ocasio and Joseph (2018) opine that a teaching strategy is a method utilized in order to assist learners in the learning of the prescribed subject content and be able to develop attainable goals in the future. Rahayu and Siregar (2018) posit that a teaching strategy is how a teacher behaves educationally; utilizing methods, tools, techniques, discipline and communication for the achievement of set goals and objectives. A teaching strategy indicates a series of teacher directed undertakings that result in learners’ knowledge acquisition in a classroom (Kumar, 2018). Furthermore, a teaching strategy can be understood as a technique and a method that a teacher employs to transfer knowledge to learners through instruction in a classroom (van der Wal & Jojo, 2014). A teaching strategy can also be understood as guidelines that the teacher integrates for the promotion and enhancement of learning. This implies that the teaching strategy should by and large be determined by the subject content to be delivered. On the same note, it is important for teachers to consider the nature of the learners taught and their levels of ability when making a choice of teaching strategies.

When explaining a strategy in a generic sense, mention was made of the fact that it involves the mobilisation of resources to be utilised in an endeavour to achieve set goals (Ocasio & Joseph, 2018; Freedman 2013; Owens, 2007). Drawing attention to the classroom context, it necessitates and appeals for the teacher’s consideration of all the resources to be used when delivering particular content. It further clarifies that a teaching strategy is not well designed if it leaves out the LTSM to be utilized including props, textbooks and other teaching/learning aids to enhance learners’ understanding. Owens’ (2007) postulation that a good strategy should incorporate technology suggests that among the resources to be considered for effective teaching, information and communication technology (ICT) should be looked at. Fernando and Marika (2017) indicated that the use of ICT enhances interaction between learners and their teacher as well as between the learners themselves.

A teaching strategy should be a means of connection between the content to be delivered and the desired outcome which is the achievement of set goals. Kumar

(2018) opined that teachers should apply appropriate teaching strategies that best suit specific objectives and envisaged outcomes. Owens (2007) asserted that the primary aim of a strategy is for excellence in achieving goals and objectives as well as outperforming competitors. In a teaching and learning situation, a teacher sets goals and objectives to achieve set performance targets and, in the process, teachers and learners are confronted with a challenge of producing good performance in the subject against the performance benchmark as well as performing better than other schools as their competitors. For that, teachers need to adopt appropriate and effective teaching strategies or methods that best suit their objectives and envisaged outcomes; and to give the teachers and learners a competitive edge over their competitors. This suggests that the choice of a teaching strategy, guided by the availability of resources as well as learners' preferences (Wesonga and Aurah, 2019), should be propelled by the urge to excel in producing good results. It has been established by research that the choice of a teaching strategy has an impact on the learners' performance (Wesonga and Aurah, 2019; Adunola, 2011).

### 2.2.3 Types of teaching strategies

Fernando and Marika (2017) shared different types of teaching strategies as espoused by the Malawi Institute of Education. These teaching strategies are lecture, question and answer, buzz group or group discussion, brainstorming, role play, case study, debate and field or educational visits. Teaching strategies are divided into two broad categories which are teacher- centred and learner- centred approaches (Kucharčíková & Tokarčíková, 2016), or traditional and participatory teaching strategies (Fernando & Marikar, 2017). In the teacher-centred approach, the teacher passes knowledge to learners through lectures and direct instruction; and learners are considered to be empty vessels and passive recipients of information. The teacher-centred approach is referred to as traditional teaching or direct instruction (Djenic & Mitic, 2017). In the learner-centred approach, teachers and learners play an active role in the learning process where the role of the teacher is couching and facilitation. The learner-centred approach is also known as participatory teaching or interactive teaching and emphasizes the involvement of learners in their own knowledge construction. Kucharčíková and Tokarčíková (2016) assert that any teaching strategy requires the support of learning and teaching

support materials (LTSM) such as audio-visual devices, flipcharts, a projector, whiteboard, computers, and various educational films.

### 2.2.4. Performance in mathematics

Goal 9 of the Action Plan to 2019 towards the Realisation of Schooling 2030 aims at improving the average performance of Grade 9 learners in mathematics (DBE, 2015). This goal suggests that the performance of Grade 9 learners in mathematics is unacceptable and needs attention. The level of performance in mathematics which is a pass at 50% has been a cause of high failure rate in the senior phase; given that a pass in mathematics is set as a promotion requirement. Learners find it difficult to perform at the set standard, thus making mathematics the least performed subject in the senior phase.

The outcomes of the Annual National Assessment (ANA) and the Trends in Mathematics and Science Study (TIMSS) confirm the poor performance in mathematics in the senior phase. According to the TIMSS report of 2011, three-quarters of learners in Grade 9 still had not mastered basic understanding of whole numbers, decimals, operations or basic graphs (Spaull, 2015). Another observation by (Spaull, 2012) is that learner attainment in mathematics in South Africa is abnormally below standard, shocking (Siyepu, 2013) and that it underpins social inequality and is a poverty trap (Spaull, 2015). This underperformance in not only in grade 12 but it cuts across all grades. This is evidence of content deficit which has its roots in the early years of the learners' schooling. The content deficit is carried on and it accumulates as learners proceed with grades (Spaull & Kotze, 2014). Spaull (2015) adds that this gap in the learners' acquisition of basic understanding is because of the shortfall of basic content knowledge and pedagogical skills among teachers.

It has been pronounced and echoed that mathematics teaching and learning within African countries has been a cause for concern to all educational stakeholders despite all endeavours towards its deconstruction (Jojo, 2019; Salami & Okeke, 2017). The challenge is that both teachers and learners lose interest in the subject

and there is a decline in the number of learners enrolling for mathematics every year. This situation led to the introduction of mathematics, Science and Technology (MST) schools to increase the number of learners in the sciences. Mutodi and Ngirande (2014) reported a similar experience in Nigeria where learners discontinued mathematics beyond compulsory education for the same reason that it is perceived as a difficult subject.

### 2.2.5 Experiences in Mkhuhlu Circuit

An analysis of the performance of Grade 9 learners in mathematics at Mkhuhlu circuit revealed an unacceptable level of performance. All Grade 9 learners in Mpumalanga write Provincial Common Assessments (PCA) on a quarterly to enable a comparative analysis of the performance of the focus subjects including mathematics. Despite the standard set in the Learner Performance Improvement Plan (LPIP) of the Provincial department of Education to work towards passing 60% of learners in mathematics across all grades, good mathematics performance is still far-fetched (LPIP, 2018). The National Development Plan (NDP) projected that by 2030, all learners should perform at 50% and above. The set standard is to have 80% of learners performing at level 4 and above. Learner performance in mathematics at Mkhuhlu circuit is far from the set level. The percentage of learners passing mathematics at 50% and above has never reached 20% and of major concern is that the performance at 50% and above has taken a steep decline as indicated in the table below:

Table 2.1: The pass percentage rate at Mkhuhlu over a 5-year period (2015-2019)

| YEAR | PASS % | PASS AT 50% AND ABOVE |
|---|---|---|
| 2015 | 89.9 | 12,5 |
| 2016 | 81.2 | 15.8 |
| 2017 | 66.8 | 14.1 |
| 2018 | 26.4 | 1.9 |
| 2019 | 31 | 1.4 |

Source: DDD retrieved on the 13 April 2020

## 2.3 THE RELATIONSHIP BETWEEN THE CHOICE OF TEACHING STRATEGIES AND PERFORMANCE

This section focuses on the relationship between teaching strategies and learner performance. The section begins by clarifying the relationship between the teacher and the learner in a learning situation, followed by and exploration of the role of teaching strategies in teaching and learning.

### 2.3.1 Relationship between the teacher and the learner

The main purpose of teaching at all levels is basically to effect a significant and positive change in a learner (Muema, Mulwa, & Mailu, 2018). Wesonga and Aurah (2019) stress that it is the desire of every teacher to produce good academic performance. However, for effective teaching to take place there must be a special relationship between a teacher and a learner. For as much as good subject knowledge is a crucial prerequisite for good and effective teaching (Ko & Sammons, 2013), there are other essentials for good educational performance. A teacher who is rich in subject content knowledge may unfortunately not accomplish the purpose of teaching and therefore fail to achieve the desired outcomes if he or she does not know the learners they teach (Kim, 2020). Ko and Sammons (2013) argued that teachers need to know their learners and adapt their instruction to meet the needs of the learners. It is always imperative for teachers to understand the learners they teach not only as a group but as unique individuals who learn differently. The prerequisites for effective teaching and learning are flexibility, creativity and responsibility on the part of teachers to design a conducive learning environment suitable for the learner's individual needs (Wesonga & Aurah, 2019; Brumbaugh & Rock, 2011)

Teachers need to accommodate the needs, interests and concerns of each learner for the enhancement of their confidence in learning (Ko & Sammons, 2013). Brumbaugh and Rock (2011) asserted that effective mathematics teachers are those who champion the motivation of all learners to learn mathematics as well as knowing them. When we were trained as teachers, we were always reminded that "in order to teach John mathematics, you have to know both John and mathematics". This saying emphasized the fact that learners are diversified according to their levels of ability and the way they learn. It is therefore important for teachers to have plans to

meet every learner in their classes through well thought out and appropriate teaching strategies. In concert with the above view, is it imperative that teachers should plan lessons that are varied; make a good choice of teaching strategies and organise suitable resources for the enhancement of learners' interest in learning. Teachers may need to vary teaching strategies to reach out to as many learners as possible (Wesonga & Aurah, 2019).

### 2.3.2 Relationship between teaching strategy and learning

The teaching strategies employed by teachers largely determine learners' performance in mathematics (Muema, et al, 2018). A teaching strategy serves as a bridge that connects the subject knowledge the teacher intends to deliver and the expectant learners in a learning environment. Therefore, the quality of teaching presented to learners is anchored on the choice of appropriate and suitable teaching strategies (Eltanahy & David, 2018). Many teachers know their subjects very well; however, conveying what they know to learners becomes a serious challenge (Cohenmiller, Merrill, & Shamatov, Effective Teaching Strategies:A brief overview, 2018). Despite the richness and depth of the teachers' content knowledge, the teacher still needs the help of an appropriate teaching strategy to impart the knowledge to the learners. As a teacher myself, I came to realise that the choice of an appropriate teaching strategy enhances the acquisition of the intended outcomes of a lesson.

Furthermore, in order to achieve the intended outcomes of their lessons, mathematics teachers need to look for a strategy that is suitable for a specific content for effective teaching to take place; and this must happen during their lesson preparation. I agree with Enriquez, et al (2018), who asserted that teachers need to reflect on the use of teaching strategies when planning their lessons for meaningful classroom instruction. Similarly, Eltanahy and David (2018) argued that the ability to pick up a suitable teaching strategy represents the quality of teaching bestowed to learners. On the same note, effective mathematics teaching and learning is possible when the teacher employs an appropriate teaching strategy that encourages learners' active participation (Ünal, 2017).

Teachers may become frustrated if they are faced with a situation of limited or unavailable teaching strategies. Omorogbe & Ewansiha (2013) reported that mathematics teaching is hampered by inadequacy of teaching strategies among teachers. Teachers may have good qualifications in mathematics teaching but they still need to be developed on how to link the content they are supposed to teach with an appropriate strategy for effective and fruitful learning to take place. Furthermore, teachers need exposure to different types of strategies to enable them to make informed choices of the appropriate strategies to be used for particular mathematics content. The right choice of a teaching strategy will attract learners' attention throughout the lesson. Learners' interest will be triggered in the subject because of the strategies utilized. Ogbeba (2010) added that using inappropriate and non-effective teaching strategies impedes learners' understanding and performance in mathematics.

In support of the perception that learners' performance is affected by the effectiveness of the teaching strategies employed, Wesonga and Aurah (2019) found that many teachers preferred teacher-centred strategies to impart knowledge to learners than learner-centred strategies. Kumar (2018) also found that even though learner-centred teaching strategies like group discussions and projects proved to be appropriate in teaching mathematics, all teachers preferred the traditional teaching strategy of lecturing. Participatory teaching strategies proved to have a positive impact in the teaching of mathematics (Lwin & Oo, 2020). Similarly, Safdar, et al (2011) found that the use of ICT as a participatory mode of teaching produced good academic performance in mathematics. Existing research confirmed that variation and combination of the traditional and participatory teaching strategies was appropriate and proved effective in the teaching (Yawman & Kubi , 2018; Okwuduba & Okigbo, 2018;Ciobanu, 2018; Fernando & Marikar, 2017; Ganyaupfu, 2013; Jarvis, 2006), This principle also apply in the teaching of mathematics; as Brumbaugh and Rock (2011) emphasised that effective teaching and learning of mathematics requires a variation of strategies. As teaching strategies have a direct impact on learners' achievement (Wesonga & Aurah, 2019), it is imperative for teachers to extend their knowledge of various teaching strategies (Ganyaupfu, 2013).

It is envisaged that through education, learners should acquire skills including critical and creative thinking, decision making and problem solving, organizing and analyzing, working effectively individually and in a groups (DBE, 2011). It is only when learners are involved in investigation, formulating, reasoning and making use of proper approaches to problem solving that it can be claimed that learning has taken place (Munyaradzi, 2013). This calls for teachers to ensure that learners are given tasks to perform rather than being passive recipients of information in class. It becomes discernible that the traditional teaching approach of lecturing and teacher-chalk may not yield the required skills. There is therefore a need for mathematics teachers to embrace different teaching strategies that will contribute to improved learner performance. At the same time, there is a need for the training of mathematics teachers to develop strategies that will enable their learners to achieve the required skills (Omoifo, 2012) (Omorogbe & Ewansiha, 2013)

In support of the above, Bature and Jibrin (2015) argued that teachers must have practical knowledge of how quality classroom mathematics teaching strategies could be developed, rather than the acquisition of theoretical knowledge. Adunola (2011) posited that poor academic performance by many learners can be attributed to the usage of ineffective teaching strategies. Meanwhile, inappropriate and ineffective teaching strategies have been identified as the major cause of a decline in learners' performance; particularly in mathematics (Gengle, Abel, & Mohammed, 2017). This emphasizes the fact that teachers need to have knowledge and understanding of different teaching strategies to enhance learning and the achievement of the objectives of their lessons. Wesonga and Aurah (2019) opined that teachers must be conversant with different teaching strategies including guided inquiry, peer tutoring, cooperative learning and projects and apply them to cover different concepts. The exposure of teachers to different strategies will enable them to be dynamic in their teaching and to reach out to all learners to extend their understanding of the subject content being taught. Teachers must consider their learners' interests and differences in their choice of teaching strategies (Raba, 2017).

Based on the above, it can be confirmed that a good and appropriate teaching strategy is the basis for effective instruction and for the enhancement of learners' understanding (Habibi, Kuswanto, & Yanti, 2017). The performance of learners in

mathematics is embedded mainly on the teachers' ability and skill to choose an appropriate strategy that is suitable for the topic or content to be delivered.

## 2.4 THE PERFORMANCE OF GRADE 9 LEARNERS IN MATHEMATICS

### 2.4.1 Comparison with international standards

South Africa was one of the 56 countries that took part in the world's biggest studies (TIMSS) of educational attainment that assessed the competencies of grade 4 and 8 learners in mathematics and science in 2015. South Africa, Botswana and Norway participated with their Grade 9 learners for grade 8 mathematics assessment in the TIMMS 2015 assessment; and of these three counties, South Africa performed the least (Clerkin, Perkins, & Cunningham, 2016). Despite the fact that Grade 9 learners sat for grade 8 mathematics assessment in the international study, South Africa was among the bottom five in performance and being the second last having outperformed Saudi Arabia.

South Africa remains one of the poorly performing countries in mathematics compared to other TIMSS participating countries though it recorded a giant leap improvement of 90 points from 2003 to 2015 of all countries that participated which is equal to performance improvement by two grade levels (Zuze et al, 2018). The overall best country in terms of learner performance in mathematics, measured on the basis of the performance of grade 8 learners internationally, is Singapore with a mean score of 621. As was the case in the grade 4 mathematics, the four highest-performing countries were Singapore, South Africa presented a mean score of 372, 249 points lower than Singapore, however 34% of South African learners were able to score above the 400points level referred to as the minimal achievement level (Zuze et al, 2018).

The data indicated above portrays Africa as the least performing continent in mathematics; given that not even a single African country features in the top 10 countries. On the same note, no African country achieved an average mean score of 400 points; only Egypt was closer to that mark and scored 392 points. On the other hand, Asia appeared to be doing well in grade 8 mathematics performance noting that all the top five countries; Singapore, Republic of Korea, Chinese Taipei, Hong Kong and Japan are Asian that presented performances of above international

benchmark of 550 points. Although Africa is at the lowest peak of mathematics performance, it is encouraging to note that performance in mathematics shows an upward trajectory. Zuze et. al (2018) reported that besides having presented one-third of Grade 9 learners who performed at a minimum level of over 400 points in mathematics, equally important and interesting is that 3.2% scored above the international benchmark of 550 points.

South Africa's performance in Grade 9 mathematics based on the TIMSS assessment in comparison to other countries can best be illustrated by the table below:

Table 2.2: Mean country scores for the TIMSS 2015 Eighth grade assessment

| **COUNTRY** | **MEAN** |
|---|---|
| **TOP FIVE COUNTRIES** | |
| Singapore | 621 |
| Korea, Rep. of | 606 |
| Chinese Taipei | 599 |
| Hong Kong SAR | 594 |
| Japan | 586 |
| | |
| **BOTTOM FIVE** | |
| Botswana (G9) | 391 |
| Jordan | 386 |
| Morocco | 384 |
| South Africa (G9) | 372 |
| Saudi Arabia | 368 |

**Source: TIMSS 2015 in Ireland: Mathematics and Science in Primary and Post-Primary Schools (Clerkin et al, 2016)**

### 2.4.2 Comparison with national standards

Grade 9 marks the exit point of the General Education and Training (GET) band in South Africa. It is therefore the most important grade because the learners are confronted with an educational crossroads as they are expected to decide whether to exit the formal schooling system and join the workforce or to continue into the

Further Education and Training (FET) band (DBE, 2011). Despite the status it carries, Grade 9 is characterised by high failure rate due to underperformance in mathematics. Mathematics is a compulsory subject and a requirement for promotion to the next grade in the GET band (NPPPPR, Government Gazette, 2012). Learners find it difficult to meet the set minimum performance benchmark of level 3 (40%) since the inception of the Curriculum and Assessment Policy Statement (CAPS) and this poor performance in mathematics is prevalent in spite of all policy interventions to uplift and strengthen sciences in the country (Sinyosi, 2015).

The interpretation of this failure is that Grade 9 learners are unable to master the five main content areas of mathematics in the senior phases which are: numbers, operations and relationships; patterns, functions and algebra; space and shape (Geometry); measurement, and data handling (DBE, 2011). Achievement in mathematics is a pathway for the ability of learners to participate in society as engaged citizens; to continue studying mathematics, science and other technical subjects; as well as an important indicator of the skills acquired for the workplace (Reddy, Juan, Isdale, & Fongwa, 2019). Jojo (2019) opined that as a gateway subject, mathematics is required for learners to be admitted into high-paying and valued professions even though it has always been the least performed even in national assessments. The table below represents the performance of Grade 9 learners in the Annual National Assessments (ANA) mathematics from when it was first administered in this grade in 2012 up to 2014.

**Table 2: Grade 9 ANA performances 2012 t0 2014, Source** (Van der Berg, 2015)

| **Year** | **2012** | **2013** | **2014** |
|---|---|---|---|
| National Average | 13% | 14% | 11% |

The table depicts a sub-standard performance by Grade 9 learners in mathematics by far. The question that arises is whether or not these learners are the typical Grade 9 learners envisaged according to the prescribed content knowledge for mathematics accumulated through all the grades prior to Grade 9. A further question is whether these learners were well prepared for the content of Grade 9 level mathematics. Reddy et al (2019), posited that the role of the school is to start the learning process from where the child is, and to bridge the gap between the less prepared and better prepared learners through various forms of pedagogical support.

On this note, schools are expected to impart grade relevant subject knowledge and ensure mastery by learners before they proceed to the next grade. Schools with more resources and better facilities are at an advantage (Zuze L. , Reddy, Visser, Winnaar, & Govender, 2018).

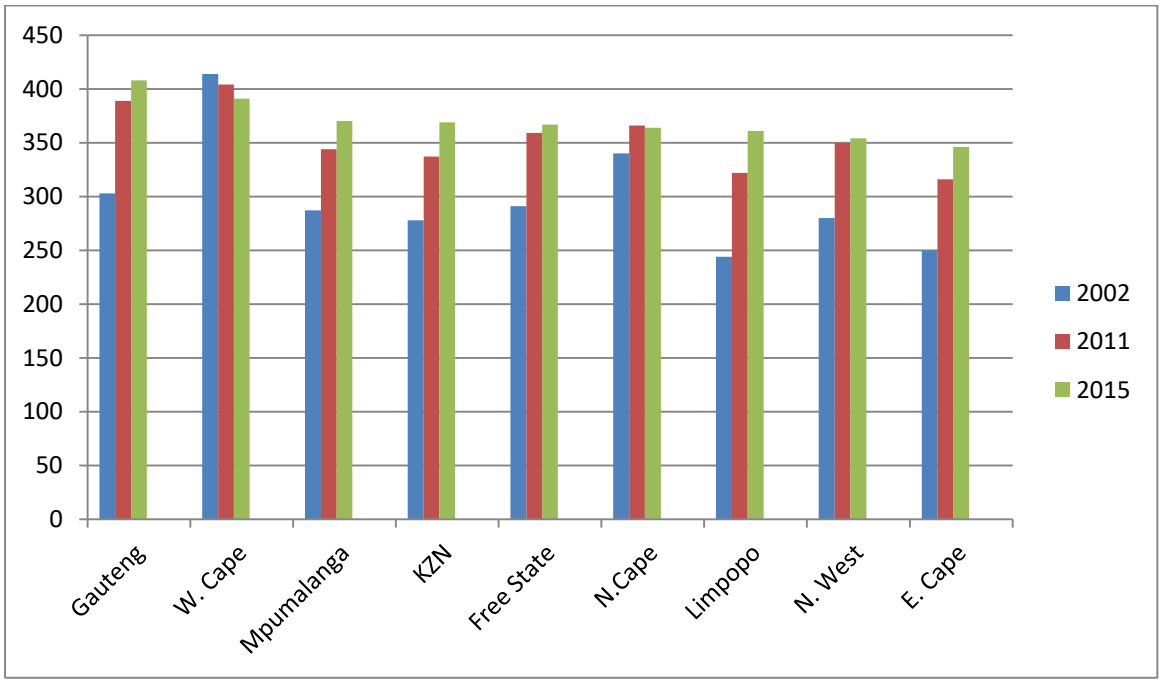
Pournara et al (2015) painted a quintessential picture of a Grade 9 learner as the one who brought sound mastery of grade 8 mathematics subject content to the grade; taught by a teacher who possesses good subject content knowledge and utilizes the required teaching and learning resources to cover the prescribed grade curriculum. We are aware that in South Africa this is a reality that is far-fetched for most Grade 9 learners presently, and this is a challenge the entire system is confronted with. There is a dearth of the necessary facilities and equipment to provide effective mathematics teaching and learning in many schools offering mathematics (Staden & Motsamai, 2017). We are aware as an education system that some of the learners that are received in Grade 9 could have moved within the senior phase without having met the set pass requirements because of the special dispensation.

The special dispensation offers learners an off ramp from the pass requirements in the GET which is set as a compulsory pass at level 3 which is 40% in mathematics, and they are allowed to proceed to the next grade even if they failed mathematics (DBE, 2016). This condition suggests that there is a high possibility that a majority of learners who are admitted in Grade 9 could not have passed mathematics from grade 7 and therefore lack the basic competences of a mathematics learner in the senior phase. The age cohort in the progression within the NPPPR allows learners who failed to meet the minimum levels for promotion to be progressed to the next level on condition that such learners should not spend more than four years in the phase. Staden and Motsamai (2017) reported that a teacher participant in their study acknowledged that all the Grade 9 learners at the time of the study had not achieved between 30% and 49% in their previous grade and that mathematics scores were adjusted to level 3 by the Grade 8 mathematics teacher.

The trend in mathematics performance by provinces is mirrored by the graph below as measured by the TIMSS assessment from 2002 to 2015. It is interesting to note that all provinces registered an upward trajectory in the 2015 assessment except for

the Western Cape and Northern Cape. The Gauteng province managed to score points above 400. Mpumalanga province achieved a mean score of below 400. It is, however, encouraging that there was consistent improvement from 2002 and out of the 9 provinces it came out as position 3 in the 2015 TIMSS assessment.

**Figure 2.1: Grade 9 TIMSS mathematics performance in South Africa**




**Source: Zuze et al, 2018**

It is worth mentioning that the performance in mathematics across all grades is a disconcerting issue given the design of the curriculum in South Africa which declared mathematics as a compulsory subject from grade 1 to Grade 9. The nature of the curriculum and the standard of attainment in mathematics are justified by the value and importance that mathematics carries as a subject in the curriculum (Sa'ad, Adamu & Sadiq, 2014). The indispensability of the subject is emphasised in the fact that it is the cornerstone for development as it prepares learners for their future; irrespective of their career choices (Davies & Hersh, 2012); (Salami & Okeke, 2017). It is mathematics that enhances the development of mental processes that enable logical and critical thinking, accuracy and problem solving that will contribute in decision-making (Department of Education, 2011). Mathematics is also crucial for socializing in public life ( Ayal, Kusuma, Sabandar & Dahlan, 2016).

The poor performance of grade 9 learners in mathematics in South Africa is also captured in the 2011 TIMSS where the learners sat for a grade 8 test and only 3% of them scored above the TIMSS benchmark; the same picture that was presented by ANA 2012 and 2013 (Spaull & Kotze, 2014). This indicates that Grade 9 learners are not equipped with the basic mathematics content knowledge befitting their grade level. The existing knowledge gaps in mathematics present an indispensable fact that senior phase learners cross over to the Further Education and Training band (FET) having not mastered fundamental concepts that should be a strong base to build the FET content on. Mathematics teachers in the FET are confronted with a challenge of closing the content gaps in order for them to pass learners; which is exacerbated by the department's decision to progress learners who failed to meet minimum mathematics requirements in the senior phase (Jojo, 2019).

The quality of mathematics teachers also contributes to the underperformance of learners in South Africa. Literature reports that it was a deliberate underdevelopment by the former regime where under qualified and underprepared teachers were appointed to teach mathematics (Jojo, 2019). It is further presented that mathematics teachers fail to answer questions in the same curriculum and grades they are teaching. This is a challenge because a teacher who is incompetent, with sub-standard subject content knowledge, will always struggle to deliver a quality lesson in class to the learners' understanding (George & Adu, 2018). As a result of this, learners' mathematical development is hindered and the learning environment becomes counter- productive. This strengthens the point expressed by the National Education Evaluation and Development Unit (NEEDU) that poor learner performance in mathematics is by and large because of the teachers' poor subject content knowledge (NEEDU, 2017).

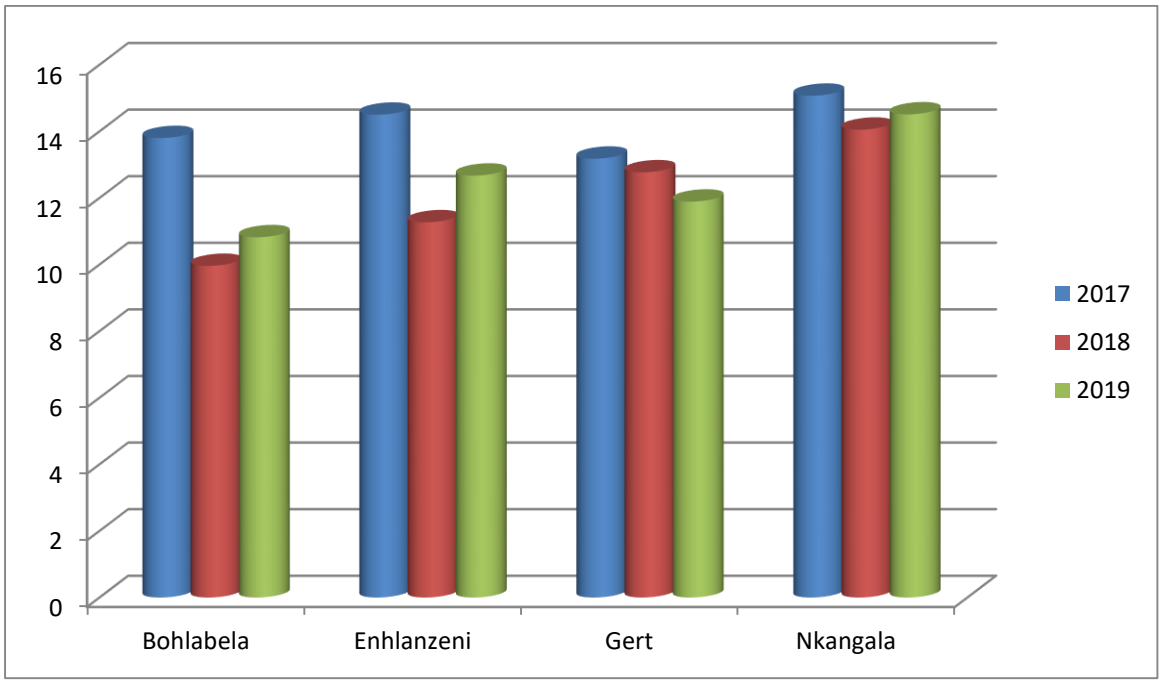
In order to guarantee improvement of performance in mathematics, the department of education must present a good, innovative, competent, warm and welcoming teacher before the learners (George & Adu, 2018). Furthermore, the teacher must have a good attitude and love for the subject; coupled with the mastery of the learning content which is imperative in triggering learners' interest in the subject. George and Adu (2018) recorded that among others, the attitude of mathematics is fundamental in the development of learners' interest in the subject. This suggests

that a teacher, who is rich in subject content; loaded with a positive attitude and the ability to create a positive and conducive learning environment, will have motivated learners who will perform well in mathematics. However, contrary to the envisaged and aspired standard, contemporary mathematics teachers have existing subject content knowledge gaps and contrasting models of classroom practices which fuel learners' anxiety in mathematics (Jojo, 2019).

### 2.4.3 Comparison with provincial and district standards

The Mpumalanga Provincial Department of Education is made up of four education districts which are: Bohlabela, Enhlanzeni, Gert Sibande and Nkangala. Bohlabela district is generally the least performing of the four districts and the whole Province has for many years been led by Ehlanzeni district in terms of learner performance. Despite the differences in performance by the different districts, performance in mathematics is still a disconcerting issue in the province. The graph below represents the Annual Provincial Common Assessment for mathematics in the four districts:

**Figure 2.2: Grade 9 PCA mathematics districts performance (Percentages of 50% and above).**

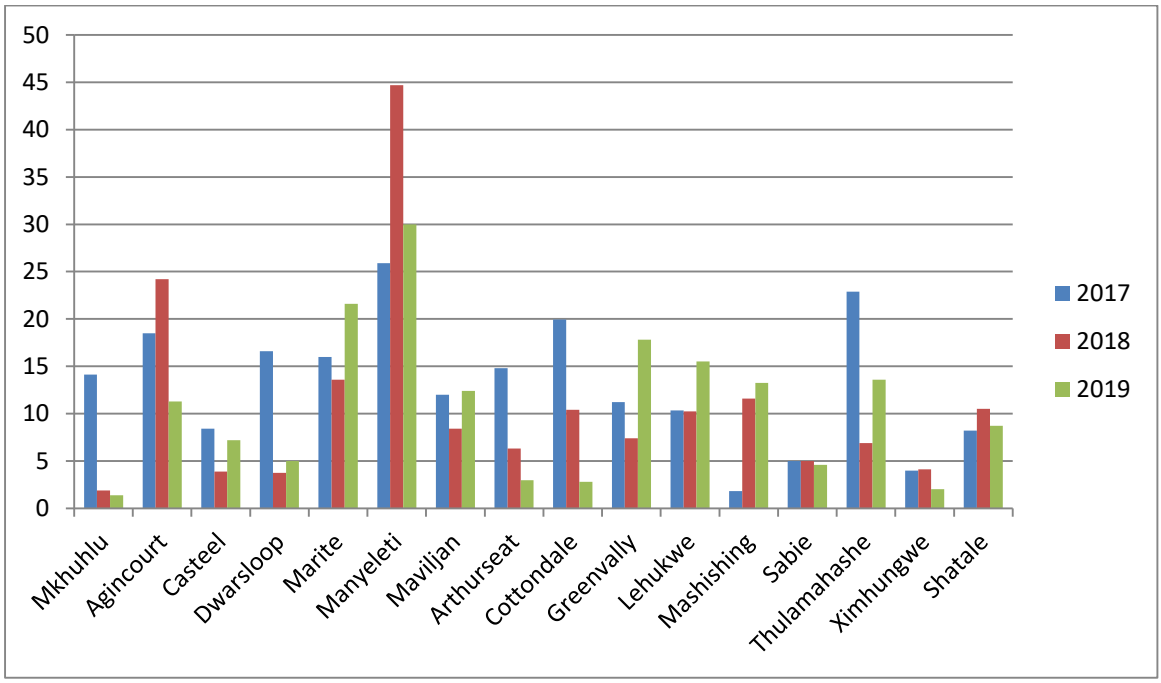



**Source: DDD retrieved on the 13th April 2020.**

Out of the four education districts in Mpumalanga, the performance of the Grade 9 learners in Bohlabela district based on the PCA end of year results for mathematics is the lowest. Except for 2017, in which Bohlabela's performance was above that of Gert Sibande district, there is no other year in which it was not outperformed by the other districts. Despite the fact that the other three districts present better results than Bohlabela, they all are far from the set benchmark for mathematics performance. It is therefore safe to conclude that Mpumalanga's poor performance in mathematics can be attributed to the inability of its districts to improve learners' academic performance to the required standards. The Mpumalanga Department of Education has a role to play through the four districts to design and implement intervention strategies to improve the level of learner attainment in mathematics.

A glimpse into the 16 circuits of Bohlabela district revealed a downward trajectory in the performance of Grade 9 learners in Mkhuhlu circuit. In 2017 to 2019, the Grade 9 learners showed a steep decline in their performance in mathematics. The graph below mirrors mathematics as the worst and most challenging subject for all circuits, more especially for Mkhuhlu in comparison with the other circuits in Bohlabela district. It is important to note that most circuits registered some improvement in the number of learners obtaining 50% and above in the 2019 fourth term PCA and this is the required standard of achievement in mathematics except for Mkhuhlu circuit. These percentages are a r3eflection of the quality of mathematics passes; given that the adjustment of marks is allowed in the senior phase. Mathematics is poorly performed at Mkhuhlu circuit and that is the driving force that prompted this study.

**Figure 2.3: Percentage of Grade 9 mathematics learners performing at 50% and above on PCA**




**Retrieved from DDD on the 13th April 2020**

## 2.5 LINKING THE PERFORMANCE IN MATHEMATICS TO THE TEACHING STRATEGIES

### 2.5.1 Countries with good mathematics performance

Looking into the practices of countries with outstanding learner performance in mathematics cannot necessarily be a recipe for success for struggling education systems but could assist in unveiling what could be possible to achieve (Graven, Venkat, Essien, & Vale, 2019). On the same note, identifying what works in successful education systems is a good step in the right direction but it should be considered that what is effective in one education system is attached and overly controlled by the context of that country. Countries are different in a number of aspects; including cultures and values, economic development and ratings, regards for and zeal towards education as well as available resources. What works for one country might not work for another but there is no harm in trying. Graven, et al (2019), postulated that effective practices that work for one country to improve performance in mathematics can only be considered as options in other countries.

There are five countries which performed above the international benchmark of 550 scores in the TIMSS 2015 grade 8 assessments. Singapore presented an average

performance of 621 scores; followed by Korea with an average score of 606, and Chinese Taipei with an achievement of 599 scores (Thomson, Wernert, O'Grady, & Rodrigues, 2016). It is a fact that these high performing countries do something differently from the poor performing countries. It is the interest of this study to zoom into the practices of these countries; particularly on their mathematics instructions.

***Singapore***

Mathematics in Singapore is compulsory until the end of the secondary education; characterised by a curriculum that is not content congested (Boyd & Ash, 2018) and is tailor-made to meet the needs of individual learners at school (Kaur, 2014). Kaur (2014) further indicated that the aim of mathematics education is broadly directed towards the acquisition and application of mathematical concepts and skills by learners; the development of cognitive and metacognitive skills through mathematical approaches to problem solving, and to develop within their learners, a positive attitude towards mathematics. The aim presented above for the Singapore mathematics education serves as the foundation of their winning plan towards good performance; more especially in the development of positive energy and willingness among their learners to do mathematics. More intriguing is the fact that every learner is presented with an opportunity to do mathematics that suits their learning ability. This suggests that not all learners within a particular grade, particularly in the secondary school would be served similar subject content because the curriculum is differentiated to cater for the learning abilities and needs of learners in different courses pursued (Kaur, 2014).

Ramelan and Wijayu (2019) opined that there are a number of factors that underpin the performance of learners in mathematics in Singapore. These include curriculum content as explained in the previous paragraph; instructional resources and teaching strategies (Ramelan & Wijaya, 2019). In addition to these factors, the recruitment of suitable teachers can never be under-rated. On the same note, Toh (2017) emphasized that mathematics curriculum tasks are better launched by teachers with strong subject content knowledge than it is done by teachers with low content knowledge (Toh, 2017). Apart from the quality of their textbooks which carry a large portion of material that promotes creative thinking in their learners (Ramelan &

Wijayu, 2019), Singaporean mathematics achievement can be linked to their teaching strategies.

The classroom arrangement is designed to foster collaborative talk among learners, well known as cooperative learning. Cooperative learning is achieved through heterogeneous grouping of learners within a classroom which allows effective peer support (Boyd & Ash, 2018). Collaborative engagement includes effective utilization of concrete objects as teaching aids, manipulative, and sharing of ideas towards possible solutions to a presented contextualised problem in class. This is based on the major principle of the Singaporean mathematics referred to as the Concrete-Pictorial-Abstract heuristic which is anchored on Bruner's enactive iconic and symbolic ways of instruction (Boyd & Ash, 2018). This suggests that there are enough LTSM in every classroom that enhances learners' understanding. Furthermore, Singaporean teachers use questioning to support collaborative learning to trigger in-depth investigation by learners in the teaching of mathematics (Boyd & Ash, 2018). Boyd and Ash (2018) asserted that teachers take advantage of their content rich textbooks and resort to and be comfortable with the telling method of teaching.

***South Korea***

The South Korean society has high regard for education and prioritizes mathematics teaching and learning; supported by parents who display a positive interest in the education of their children (van der Wal & Jojo, 2014). Subsequently, based on the 2015 TIMSS grade 8 mathematics performance, it is clear that there is something that can be learnt from their mathematics instruction practices and techniques. Research recorded that learners in South Korea have an advantage of a calibre of teachers with more advanced teaching skills; who are highly conversant in differential teaching suited for and catering the distinct need of their learners (van der Grift, Chun, Maulana, Lee, & Helms-Lorenz, 2017). These scholars further clarify that advanced teaching skills yield learning gains for both gifted and struggling learners. Teachers are better placed to understand the diversity of their learners' learning styles. Moreover, the teachers consider the learning methods preferred by learners. This leads to the better choice of teaching strategies as van der Wal and Jojo (2014) opined that the selection and successful implementation of good

teaching strategies is all it takes for good performance in mathematics and not the complete paradigm shift in curriculum.

South Korea, however, received a lot of critics regarding the efficiency of its education system with special reference to mathematics. It was discovered that despite the global intent to move away from the traditional method of teaching, which is basically knowledge transfer from the teacher to the learner, most schools were found to be still glued to these techniques and teaching strategies (van der Wal & Jojo, 2014). Teachers prefer chalkboard instruction; do most of the talking in the classroom, and whole group teaching contrary to what their learners preferred. A study conducted by van der Wal and Jojo (2014) revealed that learners in South Korea preferred to be taught as individuals for better content understanding and self-discovery where teachers would give guidance and allow learners to work on their own. It is worth noting though, that South Korea's good performance could be ascribed to their embrace and use of technology. There are computers, internet, LCD screens and smart-boards in all classrooms. These resources enable learners to access vast sources of e-material for individual as well as small group learning. The learners' willingness to learn adds to South Korea's winning recipe because the learners are motivated to learn. The school day in South Korea starts at 9h00 until 17h00, and then they proceed to private after school called hagwons up to 22h00 and dinner is served at schools in South Korea (van der Grift, et al, 2017).

### 2.5.2 Countries with poor performance in mathematics

Sub- Saharan African countries have presented relatively very low scores when compared with other countries in international assessments (Sandefur, 2016).

#### *Zimbambwe*

For socio-economic growth, it is important for a country to strive for knowledge and good performance in mathematics as a subject. However, it appears far-fetched for Zimbabwe where the country recorded 0% pass rate for grade 7 learners in 2013 (Mupa & Chinooneka, 2015). Good performance in mathematics is the foundation for development; given that learners become equipped with basic skills required for a myriad of careers. Mupa (2015) argued that among other reasons, teaching strategies are the major contributory factors to poor results in mathematics. It is the ineffective teaching of the subject; stemming from inadequate utilization and

variation of teaching strategies that consequently results in underperformance in mathematics (Mupa, 2015).

Furthermore, the choice and implementation of poor teaching strategies breeds ineffective instruction where learners fail to understand the mathematical concepts taught; which is the case in Zimbabwe (Mupa, 2015). If the teachers are unable to capture the attention of the learners through fascinating lesson presentations, learners lose interest in the subject and this becomes a brilliant formula for underperformance. Another challenge in the teaching and learning of mathematics is the negligence of interactive strategies that allow learners active participation in lessons like discovery method (Mupa, 2015). A study conducted by Mupa and Chinooneka (2015) revealed that teachers do not alternate their teaching strategies and they do not arrange and put together different media for utilization in the teaching and learning of mathematics.

Mathematics teaching in Zimbabwe is hampered by the lack of relevant resources. Mupa (2015) emphasized the fact that learners should be presented with competent teachers for effective teaching and learning of mathematics to take place. Experienced teachers who acquired better knowledge of the subject through marking experience and the availability of teaching resources such as textbooks are crucial for the envisaged improvement in the performance of mathematics. Teachers' instructional materials are confined to syllabi and textbooks only. Over and above that, schools do not even have enough of those textbooks; revision books as well as resource books for the enhancement of participatory learning by learners ( Mupa & Chinooneka, 2015). Consequently, this model of teaching reduces learners to objects and not partners in the construction of their knowledge.

According to Chikodzi and Nyota (2010), the teaching of mathematics by teachers inhibits exploratory and self-discovery learning by learners and hampers the development of problem-solving competencies. They discovered that teachers give learners worked examples of mathematical problems and ask them to follow the examples and mannerism in the rest of the tasks given. Learners are not provided with space to learn in their preferred styles as teachers use expositions which undermine the learners' capabilities as knowledge constructors. The role of teachers here is knowledge transmission and to stimulate the development of certain traits in

learners such as precision, concern for thoroughness and elegance (Johnston-Wilder, Johnston-Wilder, Pimm, & Lee, 2011).

Naturally, teachers become inclined to traditional teaching styles of explaining and lecturing with minimal utilization of other teaching aids but traditional mathematics equipment and normal text. Certainly, the inability of teachers to use appropriate teaching strategies and learning aids may lead to rote learning by learners and the spontaneous use of the symbols without much understanding and failure to link the mathematics to real life situations (Abramovich, 2017). When learners are portrayed as passive recipients of information in class, they are denied an opportunity to fully understand the learning area or content taught and the objectives of the lesson are never attained to the detriment of the learners which is evidenced in poor performance.

***Nigeria***

Underdeveloped countries suffer an impasse in development due to a weak mathematics base where the performance of their learners in mathematics is comparatively low compared to the developed countries despite having prioritised mathematics as a gateway subject into science, technology, engineering and mathematics careers, and Nigeria is one of them (Awofala & Lawani, 2020). Abdulkarim and Baba (2019) claimed that learners' academic performance in mathematics is influenced by teachers' instructional strategies and learning material and that poor performance in mathematics can be blamed on the techniques employed by some teachers in teaching this subject. Teachers adopt mechanical and non-fascinating teaching strategies which are devoid of the mastery of main ideas by learners (Abdulkarin & Baba, 2019). These researchers further argued that some teachers are glued to teacher-centred teaching strategies and neglect the novel techniques in mathematics teaching. Awofala and Lawani (2020) had a similar observation and presented that Nigerian mathematics classes are dominated by teachers dishing out information and facts to the whole class and in the process disregarding the intellectual diversity of their learners.

Mathematics teaching demands the adoption of a differentiated approach in order to meet the diverse needs of learners and calls for teachers to be flexible in their planning and lesson presentation. Teaching strategies that regard learners'

individual differences in classrooms will include group work, scaffolding and whole class teaching with verbal reinforcement that Nigerian teachers neglect (Abdulkarim & Baba, 2019; Awofala & Lawani, 2020). Another challenge is that teachers are failing to embrace technology in their teaching and the learning environment triggers a negative attitude and phobia towards mathematics; making it a big task to improve the performance of learners in the subject (Abdulkarim & Baba, 2019). Awofala and Lawani (2020) lamented the fact that learners' learning is impeded when teachers deliver their lessons without recourse to the diverse nature of learners in mathematics classes. Some learners would easily grasp the mathematical concept if individual attention is provided and technology is used to allow learners space to learn by themselves and make their own meaning of the learnt content.

## 2.6 MANAGING TEACHING STRATEGIES - MONITORING AND SUPPORT PROVIDED TO MATHEMATICS TEACHERS WITH REGARDS TO TEACHING STRATEGIES

It is the role of principals to provide leadership and management as the head of the school and the supervisor of all School Management Team (SMT) members for the proper functioning of the school. In the 21st century, schools need principals who will no longer render administrative duties only, but instructional leaders who will define and communicate school vision and mission to all relevant stakeholders, manage teaching and learning programmes, advance teacher development, supervise curriculum management, create a supportive environment ensures resource provision and monitoring learner performance (Trinh, Pham, Cao, Nguyen, & Tran, 2019). The leadership styles of the principal(s) either make or break school functionality. Poor leadership by principals is among others the force behind mediocre educational outcomes and decline in learners' academic performance; given that their core responsibility is to improve learner performance through teacher development for better performance (Trinh et al, 2019).

Principals are expected to provide leadership that is geared at the improvement of learner performance through the management of teaching and learning practices. Similarly, principals must fuel teachers' commitment to their work through robust support and motivation to improve their teaching practices (Trinh et al, 2019). Principals and SMT members must ensure that teachers are resourced with all the

necessary teaching and learning aids. Furthermore, they must focus more on what transpires between the teachers and learners in the classrooms. The SMT is entrusted with the responsibility of curriculum management to ensure that teachers prepare their lesson, look into the teaching strategies employed by teachers, tracking content coverage by teachers and quality assure learners' assessment for good performance. McAleavy, Ha and Fitzpatrick (2018) reported that in Vietnam, principals engage in curriculum management where they conduct planned and unannounced class visits to observe teacher's instructional practices. Interestingly, these principals go an extra mile and call for regular reports from individual teachers about their performance (McAleavy et al, 2018). Teachers are encouraged to develop their personal teaching programmes for each quarter; specifying the strategies to be employed and teaching activities to achieve their teaching objectives. Despite the quarterly performance reviews that principals normally conduct to gauge learner performance, the value of the management of the teaching and learning practices, especially zooming into the appropriateness of the teaching strategies employed by teachers is indispensable.

SMT members have a role to play in the management of teaching strategies for the achievement of the objectives of their lessons and ultimately the overall performance targets of the school. Class visits for lesson observation remain the primary technique to be used by school managers to monitor teaching strategies for productive learning and for the teachers' professional development (McAleavy et al, 2018). While ensuring that teachers have prepared their lessons, principals and SMT's must not be satisfied without checking the planned strategy for the lesson as planned by the subject teacher and further support the teacher in ensuring that the relevant learning and teaching support materials are provided. A study conducted by Adu et al (2017) that focused on the learners' perception of the importance of using teaching resources in mathematics revealed that using teaching resources in mathematics is important to enhance effective teaching and learning. Moreover, it does not only promote learner performance but also eradicate learners' phobia for mathematics. These scholars impress on the importance of embracing technology in the teaching of mathematics by introducing facilities such as overhead projectors, tablets, iPads, games etc. for better results.

School principals are the central role players in ensuring curriculum management and accountability as they conduct their duties as in-school monitors (McAleavy et al, 2018). Equally important is the role of principals in the provision of resources to support and enhance quality teaching. The introduction of technology rich environments and multi-sensory resources makes the learning environment to be interesting and conducive for learners to engage in interactive learning. Adu, et al (2017) opined that effective teaching of mathematics requires schools to have teaching resources like games and puzzles, graphs and charts, bulletin boards, and textbooks that contain appropriate examples. Learners gain and develop a myriad of skills when they have access to the required resources for mathematics learning. Moreover, the effective utilization of resources by teachers promotes problem solving abilities during the classroom activities as learners are presented with an opportunity to collaborate among themselves. Likewise, an interactive learning environment has the capacity to contribute positively to the learners' academic achievement as it enforces individual and group learning.

## 2.7 THEORETICAL CONSIDERATION

This study focused on the Constructivist Theory of Learning on the grounds that it is a theory that clarifies the manner in which people learn and acquire knowledge (Bada, 2015). As this study sought to explore and suggest different teaching strategies for improved mathematics performance, constructivism became the perfect lens. Moreover, constructivists believe that knowledge construction is an individual's self- regulated process and not just a mere transmission from one person to another (Larochelle & Bednarz, 1998). Vygotsky's social constructivism presents that knowledge construction within a person is a result of an individual's interaction with a more knowledgeable person (Powell & Kalina, 2009). Learning in a constructivist class is an interactive process of knowledge sharing between a teacher and a learner. Bada (2015) postulated that in a constructivist learning environment, learners assume an active role while the teacher facilitates and authority is shared between the two.

This paradigm of how people learn provides an understanding which is crucial for teachers; particularly towards the design and choice of teaching strategies. Teachers must prepare lessons that will engage and propel learners' participation in

their learning rather than them waiting for information from their teachers. The ideal role of a teacher in a class should be to establish a social, interactive and collaborative context. Borg, Hewitt and Jones (2016), argued that constructivist teaching is inherently learner-centred. Based on the above, teachers must ensure that their choice of teaching strategies incorporates and engagement of learners in cooperative learning for meaningful knowledge construction. Discussions during lessons and group work must be free and encourage learners to have ownership and a voice in the learning process.

The constructivist theory of learning provides a framework that enhances deeper understanding of the models of mathematics teaching and learning. The relevance of every strategy that teachers use in the teaching of mathematics must be assessed based on the key ideas presented by this theory, that is, learners' participation, collaborative learning, and learning grounded from past experiences and exchange of roles by teachers and learners in the learning process. The cornerstone of this learning theory is for learners to be given space and an opportunity to construct their own knowledge. Equally important is that teachers may not solely rely on the traditional teaching strategy where the role of a teacher in class is reduced to telling. Teachers must appreciate and embrace the modern methodology of collaborative learning. Coupled with the contemporary ways of teaching, it is imperative for teachers to study and understand the different ways that learners use for learning and their preferred learning strategies. (van der Wal &Jojo,2014)

A conclusion can therefore be drawn that the teachers' subject content knowledge is not an end in itself for quality teaching that will deliver the envisaged outcomes; but a thorough study of the learners to be taught and the teaching strategies used are important. In support of the above statement, Mattar (2018), asserted that teachers need to have thorough knowledge of their learners in order to choose appropriate teaching strategies because the focus of education according to constructivism, is not on content but process, (Mattar, 2018). The choice of learning strategies should be aligned with the available resources. Teachers may be confined to unproductive teaching strategies if the available resources fail to accommodate the need of the participatory learning advocated by the constructivist theory of learning.

## 2.8 CONCLUSION

This chapter presented a review of literature and the theoretical framework for this study. The literature that was reviewed for this study clarified the indispensability of mathematics as a gateway subject for a myriad of careers. The literature revealed that in order to uplift performance in mathematics, attention must be given to the teaching and learning practices across all grades. A comparative study of performance in mathematics in all levels was conducted and practices of best performing countries were tapped into for options to be considered when gearing for the improvement of performance in mathematics. This chapter further presented the importance of teaching strategies and the novel techniques for teaching mathematics and how learners learn; including embracing technology and the utilization of different teaching and learning resources. The role of the principal and the SMT in the management of teaching strategies was advanced as a necessity for learners' academic achievement and professional development of teachers. The application of appropriate teaching strategies as guided by the constructivist learning theory is highly recommended for fascinating lessons which will enhance learners' understanding and subsequent improved performance in mathematics.

# CHAPTER 3

# RESEARCH DESIGN AND METHODOLOGY

## 3.1 INTRODUCTION

The previous chapter outlined the reviewed literature related to the subject matter of this study and further located the study in its theoretical framework. This chapter presents in details the research design and methodology of inquiry employed in this study. Leavy (2017) opined that methodology presents a plan of how research will unfold; how the researcher will combine the different parts of research into a program that will detail how the research project will be conducted. The chapter commences with the description of the paradigm which underpinned the worldview that shaped the choice of research approach and design. Based on the context of the approach and design espoused, this chapter unveils the sampling procedures and data collection instruments employed in this study. Furthermore, this chapter presents the procedures that were used to collect and analyse the data for this study; the quality criteria, and the ethical considerations.

## 3.2 RESEARCH PARADIGMS

Neuman (2014) asserted that a paradigm is an extensive organizing substructure for theory and research that incorporates primary assumptions, key issues, versions of quality research, and methodology for the search of answers. There are four main paradigms which are extensively discussed in literature i.e. post positivism, constructivism, transformative and pragmatism (Creswell & Creswell, 2018). For the purpose of this study, constructivism, also known as interpretivist paradigm was adopted as a worldview to guide this study. The ontological and epistemological perspectives of the constructivist paradigm dismiss the availability of an external objective reality outside interaction with resourceful people (Given, 2008). Constructivism holds that reality is an outcome of social processes in which people become involved in the construction of their own knowledge and experience through social interaction. Creswell (2014) pointed out that social constructivists' assertion is that people seek understanding of the world which they live in and develop subjective interpretation of their experiences and meanings directed towards certain

phenomena. The aim of constructivist research is to explore how the world operates for the acquisition of in-depth insight of other people and to appreciate their varied lived experiences (Neuman, 2014). This paradigm is undergirded by the works of German philosophers during the nineteenth and twentieth centuries (Given, 2008)

Wilhelm Dilthy (1833-1911) asserted that humans must be studied systematically and empirically within the context of their cultural and social lives (Given, 2008). Furthermore, he emphasized the fact that the purpose of human sciences should be seen in the light of understanding the meaning people attach to their encounter with their world. In qualitative research, the researcher constructs knowledge through his or her interaction with participants. Dilthey's work stresses that in order to understand and gain insight of the interpretation people give to their life experiences; one must actually be present in the space where these people encounter these experiences. People's interpretation of their experiences is basically shaped by their beliefs and social interactions. As a researcher, I had to visit schools and interact with school managers, SMT members, teachers and learners, even their school environment through observations to construct meaning out of the manner in which mathematics is taught and learnt. The knowledge gained was through the description the participants gave of their experiences in the teaching and learning of mathematics which are unique to their school environments. Dilthy's postulation is linked to Edmund Husserl (1859- 1938), who believed that meaning is constructed through the interaction between the researcher and participants; where the participants reflect and give a description of their experiences of an occurrence and point out what was meaningful to them (Given, 2008).

The theories of John Dewey (1859-1952) and Jean Piaget (1896-1980) give clarity to the epistemological aspect of constructivism; particularly that knowledge is constructed within a social context and is an individual's self-regulated process and not just a mere transmission from one person to another (Lorachelle, Bednarz, & Garrison, 1998). On the same note, research suggested that a person is involved and participate in building knowledge, not an idle recipient of information. Constructivism guided the choice of data collection techniques. Based on the naturalistic nature of the constructivist paradigm, inquiry was conducted in the settings where the teaching and learning phenomena occurred for undisputable findings (Given, 2008). As a researcher, in a quest to understand and make meaning

of how mathematics is taught, I had to interact and be part of the environment in which teachers and learners experience instruction. Observation became the relevant data collection tool as the researcher had to be within the context in which teachers and learners interact to understand the impact of the learning environment and the teaching strategies used. Apart from the descriptions of experiences given by the participants, I was able to read what could not be put in words by being physically present in the participants' lived experiences through observation. The classroom arrangement, teachers' lesson presentation and learners' involvement in the lesson as well as the utilisation of LTSM brought up indispensable facts about mathematics teaching and learning which could not be unveiled by verbal responses which the participants gave. Eventually, the knowledge and meaning constructed was based on facts which speak to the credibility of the findings.

Equally important is the constructivist view point as presented by Lev Vygotsky (1896-1934), that knowledge construction within a person is a result of an individual's interaction with a more knowledgeable person (Powell & Kalina, 2009). The emphasis is put on reality that is socially constructed, proportional, multiple, and ungoverned by natural laws (Given, 2008). This subjective epistemology justifies knowledge and meaning construction between the researcher and the participants through the inquiry process. In terms of methods, Vygotsky's work emphasizes the importance of interviewing the participants to generate data as the inquirer targets the understanding of a phenomenon based on the views of those experiencing it. The researcher's insight and understanding are constructed together with that of the participants through their mutual interaction within the inquiry setup (Given, 2008). Interviews became the perfect process of inquiry which enabled logical discussions and exchange of ideas and where meaning and understanding came forth as a collaborative effort of the researcher and participants. The participants, as the knowledgeable people provided thick description of their interpretation of the realities based on their lived experiences by responding to the interview questions.

## 3.3 RESEARCH APPROACHES

A research approach is a plan that details the procedures and extent of research; laying out the breakdown of processes from the vast assumptions to specifics of how data will be collected, analysed and interpreted (Creswell & Creswell, 2018). This

study adopted the qualitative research approach. Patton (2018) indicated that qualitative research scrutinizes how individuals and groups of people establish their own meaning and understanding. Similarly, Creswell and Creswell (2018) emphasized that this research approach seeks to explore and comprehend the meaning people attribute to a real-life challenge. The choice of the qualitative research was anchored on the basis that this study sought to explore for deeper understanding of the implementation of teaching strategies and how teachers make choices of the strategies they use in the teaching of mathematics in Grade 9 (McMillan & Schumacher, 2010). Equally important is that this study is a purposeful inquiry of how things work in a setting where learner performance in mathematics is satisfactory with the intention of gathering different options that may remedy settings with poor performance.

Patton (2018) posited that qualitative research is personal meaning; meaning that the researcher is the contrivance of inquiry. This implies that a researcher is not detached from the study but he/she pulls in their own personal interpretation, competence, experience, background, skills and culture. I worked within the framework of my experience; acquired skills and knowledge as a teacher and a member of the society to interpret and make meaning as I interact with settings and participants.

The researcher personally visited the real-life settings and interacted with the participants to collect data while focusing on the participants' individual meaning construction concerning the teaching and learning of mathematics; particularly the choice and implementation of teaching strategies. My background as a teacher and my world view have by far influenced the meaning that I constructed through the research instruments which I used.

## 3.4 RESEARCH DESIGN

Creswell (2014) defines a research design as a mode of inquiry within any kind of research approach that presents particular direction for procedures in conducting research, also known as strategies of inquiry. As a qualitative inquiry, the case study is the research design that was followed in this study. A qualitative case study is an in-depth investigation of one or more real-life establishments including individuals, communities, events, settings, programs or social groups in their authentic context

(McMillan, 2016; Creswell, 2014). On the same note, Patton (2018) contended that a case study is a self- reliant; detailed and rich story concerning the chosen unit of analysis. Similarly, a unit of analysis or a case stands as a demonstration of a phenomenon that can be explored, described and understood (McMillan J. H., 2016). Mkhuhlu circuit was the case that this inquiry focussed on for a thorough analysis and exploration with the intention to have in-depth understanding of the teaching and learning of mathematics in Grade 9. In the quest for an in-depth understanding and meaning, the researcher partnered with the participants in order to jointly unearth and construct new knowledge.

Creswell (2014) described a case study as a flexible form of qualitative inquiry, most suitable for a holistic, in-depth and comprehensive investigation of a complex situation or an organization in context. The researcher studied the situation in Mkhuhlu Circuit in its natural setting; concentrating on the participants to get clarity on the experiences of school managers, teachers and learners on the teaching of mathematics. For a holistic investigation, the researcher spent time in the sampled schools to interact with the participants as required by the case study research design. For a thorough study of the case in its natural and undisturbed setting, multiple methods that include interviews, observations, and documents and artefacts analysis were instrumental (McMillan, 2016). Observing people in their natural environment carries the advantage of revealing intuition which cannot be accessed from other data collection techniques such as processes, structures and behaviours which participants may even be unaware of.

## 3.5 SAMPLING

Sampling is the process of drawing a smaller part from a population for a thorough study of the characteristics of the sample in order to understand the characteristics of the larger group referred to as a population; thereafter a generalization is made about the population based on the study of the sample (Johnson & Christensen, 2014) . Neuman (2014) asserted that in qualitative sampling, the main goal is to intensify the understanding of a larger operation, relationship, or social site. Furthermore, the sample presents important information and new features which enrich, enhance and accentuates aspects or characteristics. On the same note, Neuman (2014) emphasized that sampling reveals new theoretical illumination and

opens up distinguishing aspects of people or social settings, or deepen understanding of complex phenomenon, incident, (Given, 2008) or connections. In sampling, selection is made of some cases for detailed examination and the illumination gained is instrumental in the understanding of other large sets of related cases (Neuman, 2014).

For a case study, sampling refers to selecting a case and selecting data sources that propel in-depth understanding of the case (Gentles, Charles, Ploeg & McKibbon, 2015). The participants in this case study were sampled using a purposive sampling technique. Purposive sampling refers to selecting relevant samples that are appropriate for the specifications of the study (Tracy, 2013) In purposive sampling, the researcher usually lays out a set of attributes that the participants should possess and uses them as criteria to choose the participants from those people who happen to be excluded from consideration (Johnson & Christensen, 2014). Patton (2018) added that the strength of purposive sampling is embedded in the researcher's ability to choose information-rich cases for a comprehensive study.

Neuman (2014) posited that it is paramount indispensable that in purposive sampling, selection should be conducted on exclusively informative cases. Information- rich cases provide information and facts about the core matters which underpin the purpose of the study (Patton, 2018). Furthermore, with information-rich cases, the researcher gains illumination and filtered truth of matters instead of generalizations based on past experiences on similar issues. Samples were drawn from two secondary schools; one with good and the other with poor performance in mathematics in Grade 9. These schools were selected based on their anticipated in-depth and relevant information related to the study. Their experiences and their organizational cultures as good and poor performing schools in mathematics advanced my knowledge construction on the teaching and learning practices of mathematics. A sampling quota from the two schools is presented in the table below:

**Table 1: Participants from the two schools**

| **SCHOOL** | **PRINCIPAL** | **ES's** | **TEACHERS** | **TOTAL** | 1 SUBJECT ADVISOR FOR GET |
|---|---|---|---|---|---|
| **A** | 1 | 1 | 1 | 3 | |
| **B** | 1 | 1 | 1 | 3 | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | BAND |
| **TOTAL** | 2 | 2 | 2 | 6 | **7** |

**Table 2: Profiles of the educators**

| **School** | **A** | **B** |
|---|---|---|
| Teacher | Teacher ‘A’ | Teacher ‘B’ |
| Teaching grade | 9 | 9 |
| Age | Above 41yrs | Above 41yrs |
| Teaching experience | Above 11yrs | Above 11yrs |
| Gender | Female | Male |
| Professional qualifications in mathematics | STD | ACE in Mathematics |
| Post level | 1 | 2 |

**Table 3: SMT members’ profiles**

| **School** | **A** | **A** | **B** | **B** |
|---|---|---|---|---|
| School performance | | | | |
| SMT member (Principal/Education Specialist) | Principal ‘A’ | ES ‘A’ | Principal ‘B’ | ES ‘B’ |
| Management Experience | Above 11yrs | Above 11yrs | Above 11yrs | Above 11yrs |
| Age | Above 41yrs | Above 41yrs | Above 41yrs | Above 41yrs |
| Gender | Female | Male | Female | Male |

**Table 4: Subject Advisor profile**

| **Subject Advisor** | **SA** |
|---|---|
| Experience | Above 11yrs |
| Professional qualifications | BSC Honours in Mathematics |

| | |
|---|---|
| Age | Above 41yrs |
| Gender | Male |

## 3.6 DATA COLLECTION

The researcher used multiple methods of gathering data such as observation, interviews and documents and artefacts analysis.

### 3.6.1 Observation

Observation as a data collecting technique enabled the inquirer to read the non-verbal behaviours, gestures and body language of the participants (Wragg, 2013). It is, however, a fact that the presence of the observer does influence change in the usual behaviour of the participants (McMillan, 2016). Class visits to mathematics classrooms were conducted to observe the teacher-learner interaction and to explore different teaching strategies used in the teaching of mathematics. Observations help to expand a researcher's insight concerning the inquiry (Patton, 2018). During the site visits at the participating schools given the vast aspects and undertakings within schools, my focus was only on particular matters that were directly related to my study. This is in line with what Patton (2018) referred to as maximizing leverage. Patton (2018) asserted that maximizing leverage is when researchers pump up resources and extend their stay at observation sites to obtain important and relevant data for their research. Patton (2018) advised that in order to harvest a deeper understanding of undertakings or programs during fieldwork, researchers should not limit observations only to formal activities. On that note, class visits for lesson observation did not only focus on the teachers' and learners' activities during lesson presentation. Other activities that the researcher engaged in included observing the way the learners welcomed their teacher in class and the state of the classroom as a learning environment. The sitting arrangement of the learners was given attention as it does have an impact on the effectiveness of teaching strategies. Observation was also extended to the class setup in terms of the availability of LTSM; including ICT gadgets and other relevant resources. Teachers are expected to ensure that classrooms are arranged in a manner that promotes and nurtures learning and knowledge development (Brumbaugh & Rock, 2011). Therefore, my observation also

focused on the utilisation of the classroom walls by teachers to enable learners to make sense of mathematics through displays of posters for different mathematics concepts. All observations were clearly documented and all protocols were kept in all observation sessions.

### 3.6.2 Interviews

Tracy (2013) asserted that qualitative interviews create platforms for mutual understanding, discovery, reflection, and explanation through an organic and adaptive manner. Furthermore, interviews are important because they unearth hidden issues and information that is impossible to access through observations (Tracy, 2013). Patton (2015) added that interviews give participants' citations about their knowledge, experiences, opinions and feelings. Unstructured and semi-structured interviews with school principals, heads of departments and teachers were conducted. The relevance of unstructured and semi-structured interviews for this study was because of their inherent characteristics to enable the interviewees to freely express their points of view and sentiments without limitations (Tracy, 2013). Face-to- face interviews were used for data collection in a venue that was convenient for the participants. Records of the participants' responses were kept; the consent of the participants was sought to use a voice recorder during the interviews. The voice recording was used to ensure accurate capturing of the participants' responses and to augment the hand-written notes. The interviews were in all instances conducted after school to avoid disrupting lessons.

### 3.6.3 Analysis of documents and artefacts

The last method that was used for data collection is the analysis of documents and artefacts. Patton (2015) opined that qualitative research involves the search, study, and analysis of different types of documents. The researcher took time to peruse documents; including the analysis of learner performance in the internal and common external assessments. A comparative analysis of Grade 9 learners' performance in mathematics over the past three years was conducted to get a better understanding of the subjects' performance history. The profiles of Grade 9 mathematics teachers in the participating schools were also studied, paying special

attention to their teaching experience in years and their qualifications in mathematics. Minutes of departmental meetings were part of the documents which were perused in pursuit of a better understanding of the kind of support that was given to mathematics teachers through meetings and departmental interactions with their Education Specialists (Heads of Department). Monitoring instruments for curriculum management, class visits, and observation tools were also perused to establish the involvement of the SMT in terms of setting and following up on targets and priorities for teacher development and support.

## 3.7 DATA ANALYSIS

Data analysis is a process of summarizing and arranging the collected data for meaning extraction through interpretation (Leavy, 2017). In a qualitative study, data analysis entails a process of description, categorisation and the relationship of circumstances with the researcher's ideas or study (Graue, 2015). Analysis of collected data was presented in the form of major themes, i.e. thematic analysis. Codes were used to summarize the data. Coding is a process of classifying data as representing or belonging to a particular phenomenon (Tracy, 2013). Thereafter, the coded data was interpreted to extract themes, patterns and relationships (MacMillan, 2016). The summary of the themes, codes and patterns together with their relationship were analysed in detail.

## 3.8 QUALITY ASSURANCE MATTERS

The four trustworthy indicators, namely, i.e., credibility, dependability, transferability and confirmability were considered. For the purpose of this study, credibility was selected for judging its quality (Cresswell, 2014). Credibility in a qualitative study is realised through a number of processes which include thick description, triangulation or crystallization, multivocality and partiality, and engaging in member reflections with participants (Tracy, 2013). The processes which were used to ensure credibility of this study are triangulation, member checking and peer debriefing.

### 3.8.1 Triangulation

McMillan (2016) refers to triangulation as an approach that is searching for the point of intersection for findings, cross corroboration among a variety of sources and data

collection techniques. The use of multiple data collection methods to collect different data as much as possible is salient for the achievement of credibility (Tracy, 2013). It therefore implies that the consistency of results is tested through the use of varied data sources and data collected at different places, different times and from different people. For the purpose of this study, observations, interviews and documents analysis were used for data collection. I triangulated the data from different data sources in the participating schools to validate the accuracy of the findings. Assertions and interpretations derived from the data were critically examined to ensure that they are credible.

### 3.8.2 Member checking

Member checking is a process where the researcher requests the participants to verify the interpretation and conclusions drawn by the researcher for confirmation (McMillan, 2016). Tracy (2013) claimed that member checking is a practice which emphasizes the necessity for correspondence between the participants' viewpoints and the inquirer's findings. This is related to what Tracy (2013) referred to as 'member reflections. Member reflection is a process where the researcher creates space to share and discuss with participants about the findings of the study (Tracy, 2013). Furthermore, participants are accorded an opportunity to ask questions, receive feedback, critique and collaborate with the researcher as well as endorsing the findings (Tracy, 2013).

I summarised the notes at the end of the interview and observation sessions to establish the accuracy of the notes and whether or not they reflected the point of view of the participants. In wrapping up the interview and observation sessions, I took time to share the recorded notes of the participants' responses with them. The participants were therefore requested to make comments concerning the fairness, reasonableness, accuracy and completeness of the records. The participants were able to advise where they felt some gaps existed in the information provided.

### 3.8.3. Peer debriefing

I engaged another person who is detached from the study for the review of the study to ascertain whether or not the findings are connected to the data. I ensured that the person involved is conversant with qualitative analysis and has knowledge about the subject matter of this study.

## 3.9 ETHICAL CONSIDERATIONS

The word ethics was derived from the Greek word ‘ethos’ which means character (Leavy, 2017). Leavy (2017) further postulated that ethics deals with the knowledge of right and wrong, integrity, as well as fairness and sincerity. Similarly, McMillan (2016) asserted that ethics are propositions and standards utilized in research as a framework for the conduct, values and morals which distinguish the right from wrong as well as evil from good. In simple terms, ethics denotes the mannerism of conduct along acceptable standards by researchers to ensure credibility and authenticity of the study conducted. For the purpose of this study, the following principles and ethical issues were considered: voluntary participation, confidentiality and anonymity, informed consent, research integrity and the ethics policy of the university. In order to ensure ethical research practice, the following considerations were observed:

Permission to conduct the research in Mkhuhlu circuit was sought and obtained from the Mpumalanga Department of Education. Written requests were given to heads of schools to request the involvement of their School Management Team members, teachers and learners. Participants in this study were handled with great respect; they were assured that their identities would not be revealed as indicated in the sample table where letters and numbers were used instead of names. They were also assured that any information that they were going to provide would be treated as confidential. The researcher provided clarity and explained the key objectives of the study and the study processes to the participants. The participants were not coerced but they were requested and encouraged to participate in the study on a voluntary basis. They were further informed that they were free to withdraw their participation anytime they felt like doing so. The participants were not bribed to participate in the study and no payment in any form was given as a reward for their participation. A high level of integrity was maintained throughout the processes of the study and professionalism was observed at all times while dealing with the participants. The data that was collected was used in its raw form without any form of

bias or manipulation by the researcher. All the sources used were properly acknowledged to avoid plagiarism. The researcher applied for and obtained an ethics clearance from the Ethics Committee of the University of Limpopo (TREC) before commencing with the study.

## 3.10 CONCLUSION

This chapter mirrored how the research paradigm shaped the manner in which this study will be conducted from the start to the end. The approach to the research design chosen was detailed and all the processes up to the interpretation of the collected data were explored in this chapter.

# CHAPTER 4

# RESEARCH FINDINGS AND DISCUSSION

## 4.1 INTRODUCTION

The previous chapter presented the research design and methodology of the study. This chapter outlines the findings or results of this study. The findings are reported in four categories. Firstly, the chapter presents the profiles of schools and teachers. Secondly, it presents the results from the interviews held with the teachers, Education Specialists (ES) and principals of the selected schools as well as the Subject Advisor for mathematics GET. Thirdly, the chapter presents the results of the document and artefact analysis, as well as the results of the observation conducted in the selected schools. Lastly the chapter presents the themes that emerged from interviews, observations and documents analysis.

## 4.2 PROFILE OF SCHOOLS AND PARTICIPANTS

### 4.2.1 Profile of schools

The schools and participants in this study were purposively sampled based on their performance in mathematics in Grade 9. I work in the circuit and have access to the analysed results of all the schools. Based on the analysis of results for the past three years in the circuit, a school with good performance and another with poor mathematics performance were identified for the study sample. The two schools which participated in this study were selected for the purpose of understanding their teaching practices which resulted in their different performances in Grade 9 mathematics. School A and B were sampled based on their results in Grade 9 mathematics for the past three years (2017, 2018 and 2019) as indicated in the table below:

| **YEAR** | **SCHOOL A** | | **SCHOOL B** | |
|---|---|---|---|---|
| | NO. WROTE | PASS % | NO. WROTE | PASS % |
| 2019 | 202 | 2.9 % | 106 | 92.0 % |
| 2018 | 172 | 13.9% | 116 | 2.0 % |

| | | | | |
|---|---|---|---|---|
| 2017 | 264 | 17.2% | 117 | 15.0 % |

School A is a Mathematics, Science and Technology (MST) grant school. The school became part of the schools which were selected to be part of the expanded National Strategy for Mathematics, Science and Technology in 2013. The National Strategy is aimed at increasing the number of learners doing mathematics and science. s Furthermore, the strategy sought to improve teacher content knowledge as well as ensuring improved performance in these subjects. A specific budget is put aside to provide resources to these focus MST schools; including textbooks and ICT for quality mathematics and science teaching and learning. In order to meet the ideals of the department with the MST schools, all learners in MST schools are taking mathematics and physical sciences as major subjects from grade 10 to grade 12. Learners who are enrolled in these schools but still fail to pass mathematics with the required standards have a choice to discontinue mathematics and be enrolled in schools offering mathematics literacy as an alternative subject when they pass Grade 9. School A represents a school with poor Grade 9 mathematics performance at 2,9% in 2019. School B is an ordinary public school which offers a number of curriculum streams in the FET. Learners in this school are taking mathematics as a choice subject when they exit GET. School B represents good performance in mathematics at 92% in 2019.

### 4.2.2 Profiles of the participants

In school A mathematics is taught by a female teacher who is above 51years of age and has been teaching mathematics for 30 years. She is holding a PhD as her highest academic qualification but does not have a qualification or specialization in mathematics. The teacher took mathematics as a major subject when she did her professional teachers' diploma. The Education Specialist (ES) formerly known as Departmental Head, in school A is a male teacher who has been in management for four years; and 26 years teaching mathematics and is above 41 years of age. He teaches mathematics in grades 9, 11 and 12 and holds a Bachelor of Education degree in mathematics. The school principal is a female in her late 50's and has two years of school management experience. She served in the School Management Team (SMT) for more than 11 years in different levels; as a departmental head and deputy principal before becoming principal.

The mathematics teacher in school B is a male who holds a Professional Diploma in Education in secondary school teaching and an Advance Certificate in Education (ACE) for mathematics in the GET. The teacher is above 41years of age and has more than 11 years teaching mathematics. School B does not have an Education Specialist for mathematics. The mathematics department is controlled by the deputy principal who is above 41 years of age; male, and has more than 11 years of management experience. The deputy principal has a Professional Teacher's Diploma as well as an ACE in mathematics for FET the band. The school principal has less than five years of management experience as a principal; female and above 41 years of age. The finding that emerges from the profiles of the participants outlined above is that mathematics teachers in both school A and B are qualified and have remarkable experience in the teaching of mathematics.

## 4.3 RESULTS FROM THE INTERVIEWS

### 4.3.1 Interviews with teachers

The interview process with the teachers sought to solicit data based on the following factors: LTSM and other resources used in the teaching of mathematics; the strategies used when teaching mathematics, access to and utilization of ICT resources, insight about learner centred and cooperative learning, and content coverage and support received from supervisors and subject advisors.

The summary of teachers' responses is presented below:

***LTSM and other resources used in the teaching of mathematics*.**

This question sought to get insight regarding the availability of LTSM in schools; specifically, LTSM used for the teaching of mathematics. It also sought to establish if teachers used all the resources available to them for instruction in mathematics classes. Both teacher A and B were able to share a range of LTSM that they in their classes when teaching mathematics; including chalkboard and chalks, textbooks, workbooks, mathematical sets for teaching geometry, teachers' guides, and Annual Teaching Plans (ATPs). Teacher B indicated that he used the DBE workbooks in the teaching of mathematics. The workbooks are the LTSM that is provided for every learner to have a copy; unlike textbooks that are usually not enough yet they are the

least utilized in schools. In her response, teacher A did not mention the DBE workbooks as one of the LTSM she uses in teaching mathematics.

In response to the above question, teacher B responded as follows: *"I usually use the textbook, the DBE workbooks and the tracker for content coverage".* This is a loaded response which shows a sense of consciousness concerning curriculum coverage by teacher B. Teacher B also hinted to on using practical objects in class when teaching and cited an example of when he teaches two-dimension (2D) shapes. In his explanation, he clarified that there are stripes supplied by the department which are given to learners to practically construct different shapes.

Teacher As response to this question was:

*"I use chalkboard, chalks and duster, uuhm… textbooks, ATP, teachers' guide, exercise books, mathematical set when teaching geometry".*

The response of teacher A above does not reflect any sense of passion for exploring different LTSM to enhance her teaching of mathematics. While there is sufficient evidence from the responses of both teachers (A and B) that schools are supplied with LTSM that may be used to enhance the quality teaching and learning of mathematics, these resources are marginally or totally not used. Both teachers confirmed that there is no specification of resources to be used in the teaching of mathematics in the ATP. Teacher B indicated that it is only the tracker that gives guidance about the textbooks and pages in relation to activities for assessment.

The finding that emerged from the first question is that there is no guidance on the choice of and usage of teaching strategies. This implies that the improvement of the teaching and learning of mathematics depends on the creativity of the teacher to plan and arrange teaching and learning support materials for the enhancement of quality teaching and learning

***Specific strategies used to teach mathematics***

The question enquired if there were specific teaching strategies that teachers were expected to use for each topic in the ATP; and to conduct an audit of the strategies that mathematics teachers use. As a researcher, I was also interested in establishing the strategies which were preferred by these teachers for their Grade 9 learners.

Both teachers confirmed that the ATP was silent about the prescription of teaching strategies. The ATP only clarified the topics to be taught but there is no prescription of how the content should be taught. The responses of the teachers are recorded below:

Teacher 'A', *"No, ATP does not specify teaching strategies"*

Teacher 'B', *"No"*

The responses of the teachers above indicate that teachers are not guided by the ATP on how specific content should be taught. The choice of a teaching strategy is therefore dependent on the creativity of individual teacher to plan their lessons with a particular teaching strategy in mind. There is no prescription or suggestion of teaching strategies in the ATP; it provides teachers with what needs to be taught and when that content must be completed.

With regard to the question of auditing the teaching strategies, teacher A indicated that she uses the question and answer method. She explained with an example of how she teaches a basic operation which suggests that she also uses the telling method. In her own recorded words, teacher A responded as follows:

*"During presentation, I use question and answer methods. I sometimes use uhmm…, for instance when I teach them addition or basic operations, I present and tell them…"*

Teacher B responded as follows:

*"I use a combination of strategies, like 'question and answer' methods, discussion and telling methods".*

Teacher B went on elaborating on his most preferred teaching strategy and a plethora of teaching strategies which are normally used in mathematics came out. The teacher indicated that he preferred to have learners working in groups and he called this strategy 'peer teaching'. He clarified in his explanation that learners are arranged in groups and given tasks after which one member in each group presents to the class how the group approached the activity given to them and how they got their answer. As groups are given time to present, they are learning different

approaches from each other on how to find a solution to the same problem. In his own recorded words, teacher B said:

*"If ever the other group did not do the same, or in the same way, they explain how they did theirs. And you find that the answers are the same, but the methods are different".*

Drawing from teacher B's approach and strategies, learners are given a chance to explore different methods of doing a particular activity. In groups, these learners discuss and share ideas concerning the task at hand until they reach an agreement. They are exposed to collaborative learning as the teacher acts as a facilitator and a new approach/strategy called facilitation method emerges. The peer teaching strategy is called as such because these groups consult each other and learn from each other for the mastery of the learning content. Teacher B emphasized that he enforces maximum participation by all learners in the different groups by giving each learner an unannounced chance to present on behalf of the group, and this is how he puts it in the recorded response:

*"And another thing, to make sure that everyone is participating, I just pick anyone from the group to come and present on behalf of the group. After the presentation, I will just ask for inputs from the other members".*

The teacher emphasized that there are no free riders in groups as every learner within a group knows that they may be picked to present. This strategy, therefore, ensures that every member of a group works hard to understand the task so as to represent their groups well. Furthermore, the teacher clarified that there is a sense of competition and striving for excellence by all members of the different groups. In his own words, the teacher said: is:

*"These learners have a tendency of trying to outshine others"*

It is interesting to note that these learners have fun in the learning of mathematics as they all work in teams to master the learnt content with the intention of becoming the best group in the class. The teacher further indicated that he creates extra contact time with learners outside the prescribed contact time. He indicated that he conducts Saturday classes to provide uninterrupted extended hours of learning to allow learners ample time in group discussions and presentations. The teacher

designs his own uncontested ground by using weekends to be alone with the mathematics class. Mathematics is all they learn for the day and that presents an opportunity for the different groups to make their presentations and to learn from each other. This is what is referred to as cooperative learning (Dignath & Buttner, Teachers' direct and indirect promotion of self-regulated learning in primary and secondary school mathematics classes- insight from video-based classroom observations and teacher interviews, 2018).

The findings from the responses of 'Teacher B' are that using multiple teaching strategies supports quality teaching and learning in mathematics. Learners have fun and enjoy learning mathematics when participatory teaching strategies are used. Furthermore, participation is encouraged when the teaching is learner-centred and learners engage in cooperative learning.

Teacher A, on the other hand, responded by indicating that her most preferred teaching strategy is the question and answer method.

*"Question and answer method work best, because that one I use throughout the year. I ask them questions and then it provokes them to listen and to think"*

The teacher emphasized that she uses only one strategy for lesson presentation for every topic until the ATP is covered. This implies that the teacher does not alternate strategies in her teaching. Even though she clearly indicated that she likes this strategy because it provokes learners to listen and think, one strategy may not be effective for every topic. It also appeared that it is the teacher who is at the centre of the lesson; doing most of the talking while learners are quiet the entire time until the teacher poses a question. The only time the learners get involved in the lesson is when they answer questions from the teacher. This strategy sometimes limits participation as only one learner is given a chance to answer on behalf of the other learners. The learner's response provides feedback to the teacher if they understand the concepts taught or not. This is how she puts it:

*"If they give me the answers, I'm able to tell if they are with me as we proceed with the teaching or they are left behind".*

The learners who raise their hands to respond to questions from the teacher represent the whole class as an indication of whether they understand or not.

Sometimes learners are given a chance to respond as a choir; even in that case, not all of them speak their minds. In this instance, the teacher may be misled to think that the learners are following the lesson whereas they are not. In the event of a learner giving a wrong answer or not responding at all, the teacher may be compelled to repeat whereas learners have captured the concepts. In her further explanation of how she presents her lessons using the question and answer method, this is what she said:

*"If they keep quiet or don't answer, they usually keep quiet. If they keep quiet, I give them piece of work on a scribbler to find out if they understand what I was doing".*

Here, a picture is painted that sometimes it is the teacher who would have spoken throughout the duration of the lesson. The instruction is teacher- centred where learners are not granted an opportunity to construct their own knowledge as constructivism demands. The learners are passive recipients of knowledge and participate minimally in the learning process. The teaching and learning process as presented by teacher A is carried out in the traditional way of teaching where the teacher uses the chalk board and the telling method. Learners are not allowed an opportunity to explore and to have fun in their learning.

Even though the teacher prefers to use the question and answer strategy, it appears in her presentation that she becomes frustrated when it happens that learners do not understand the lesson. The only option she has if learners seem not to understand the learning content is to re-teach. This could be an indication of lack of insight about alternative teaching strategies which could be used in the teaching of mathematics. The responses to this question revealed that teacher A has only one strategy that she uses in the teaching of mathematics, while teacher B uses multiple strategies.

The theme that emerged from the responses of teacher is A that using a single teaching strategy impedes quality teaching and learning. The traditional method of teaching limits learners' participation. This finding reveals that teachers tend to be frustrated when they are conversant with only one strategy in the teaching of mathematics.

***Access and utilization of ICT resources***

The responses to this question by both educators indicated that schools have not started to embrace technology in the teaching of mathematics. School A is an MST grant school which by design should engage in e-learning where learners receive lessons broadcast from the MST main hub through electronic platforms. As a mathematics focus school, it is supposed to be well resourced with appropriate LTSM to ensure quality teaching but on the contrary, the school is not well resourced. This is what teacher 'A' said:

*"We have access to the Departmental Head's laptop, but it is one laptop for the whole department, and the DH is also using it. We have two data projectors, but we cannot use them in the absence of a laptop".*

The school has a smart-board but it is alleged that this is not used because teachers were never offered training on the use of this gadget. The learners are deprived of the fun they should enjoy in the learning of mathematics through technology. Teacher B declared that he has never used ICT resources in the teaching of mathematics and even added that they are not available at the school.

The finding from the responses to this question is that schools do have ICT resources though minimal; which teachers may utilize for mathematics teaching and learning but there is minimal or no advocacy at the level of schools to promote technology-based teaching. Furthermore, where provision is made for ICT resources, schools fail to use these resources because they are not provided with the necessary training

***Insight about 'learner centred' and 'cooperative' learning***

This question sought to tap into the teachers' insights about different teaching strategies at their disposal for mathematics instruction. Both teachers displayed an understanding of the two concepts of learner centred and cooperative learning. These were those teachers' understanding and explanation of 'learner centred' teaching:

*Teacher A: "Uhm… it is teaching that is centred upon the learners, most of the activities are done by the learners"*

*Teacher B: "Eer… I think it is where the learners' needs are placed first, you allow the learners to show what they know, and you build from what they know"*

Their responses for questions related to cooperative learning were as recorded below:

*Teacher A: "Learners are learning in a team, in a group"*

*Teacher B: "is where learners work as a team or in groups, and the role of the educator is to facilitate or mediate in the learning process"*

Drawing from the responses of the two teachers, there is evidence that they have knowledge of participatory teaching and learning strategies. Even though both teachers indicated that they do engage their learners in cooperative and learner-centred teaching, however is no evidence to support teacher A's assertion. There is enough evidence that supports that teacher B uses and shows passion for cooperative learning and learner-centred teaching than teacher A who prefers the question and answer method which is teacher-centred.

***Content coverage***

The question drawn from content coverage was intended to find out if teachers were able to cover the subject content as prescribed by the ATP. These were the responses of both teachers:

*Teacher A: "No, because the learners have information gap and as the year goes by the gap becomes wider".*

*Teacher B: "Yes, I do cover it per month".*

Teacher A indicated that content coverage is a challenge as the learners bring to the grade a knowledge gap. However, in her explanation I missed a mitigation plan to address the knowledge gap as well as a plan for content coverage. By implication, there is a continuous effort to close any existing knowledge gap at the expense of the prescribed content coverage.

Teacher B, on the other hand, shared how he manages to cover the prescribed content per month. The teacher indicated that he conducts extra classes during afternoons and weekends and that enables him to have enough time to close

existing knowledge gaps and to be on par with the ATP concerning content coverage. This aspect revealed that an extension of teaching hours outside the prescribed notional time is necessary for curriculum coverage and to deal with existing knowledge gaps among learners.

***Support received from supervisors and Subject Advisors***

The question drawn from this aspect sought to solicit insight about the kind of support that teachers receive from their supervisors and subject advisors. The teachers indicated that they do receive support from their supervisors and subject advisors. Teacher A indicated that her supervisor assists her with resources like ATP's and textbooks. She further indicated that the supervisor advises them on the subject related issues. Teacher B, on the other hand, indicated that his supervisor does co-teach the subject and they share ideas on the teaching approaches for certain topics. The supervisor conducts lesson observation as the teacher teaches and sometimes it would be the supervisor teaching while the teacher observes.

The teachers recorded that the subject advisor assists them with the formal common assessment tasks and the tracking of content coverage. Teacher B indicated that the subject advisors are always available to come to their school when they invite them to assist with subject related challenges. Teacher A indicated that the subject advisor provides her with previous question papers, baseline assessment instruments and curriculum development.

Drawing from the responses of both teachers, there is evidence that they receive support from education specialists and subject advisors. There is however, an indication that the support is hinged on the mastery of content and the tracking of curriculum coverage and less on the delivery part of the curriculum. The support does ensure availability of lesson plans, but neglect the teaching practices teachers engage in when presenting their lessons.

### 4.3.2 Interviews with education specialists (ES)

The interviews with education specialists focused on the following factors:

***Teacher development, monitoring, and support***

The participants were required to clarify if they had plans for the development of the teachers under their supervision, and to elaborate how often they monitor teachers and learners' work. The participants' responded as follows:

*ES A: "Yes, but not implemented – disturbed by lockdown and I haven't conducted class visits as of now".*

*ES B: "Not really, but I do develop teachers in terms of how they should work".*

In their responses, the education specialists exposed that they have a narrow version of what teacher development entails. According to education specialist A, teacher development is about conducting class visits only, whereas education specialist B does not have a plan at all; meaning that there is no program of development for individual teachers. However, education specialist B indicated that in their departmental meetings, they address challenges of lesson presentation and lesson study where the education specialist models a lesson presentation. They both indicated that they monitor teachers and learners' work but education specialist A monitors on a monthly basis whereas education specialist B monitors fortnightly. The monitoring focuses on content coverage and checking the number of activities given to learners; regardless of whether the learners have mastered the learning content or not.

This part revealed that mathematics teachers receive minimal development from their education specialists. In 2020, schools had a full first term before we the government declared a state of disaster and put the country on lockdown. There is, unfortunately, no evidence of teachers' development even before the outbreak of Covid-19. Furthermore, there is uncertainty on the part of education specialists on what teacher development entails. However, evidence show that education specialist B develops teachers on different approaches for lesson presentation and sharing of teaching strategies

- **Insight on teaching strategies**

The question drawn from this aspect set out to find out if education specialists have interest in and knowledge of teaching strategies used by mathematics teachers. Both education specialists recorded that teachers do plan their lessons. However, the indication was that they are less interested in the manner in which the lessons

would be presented. It appears that there is no set norm to have teaching strategies clarified in every planned lesson. Monitoring based on the ES's responses focuses much on the coverage of content and not on how the content would be taught. As mathematics teachers themselves, ES A teaches mathematics in grades 11 and 12 and due to the extension of classes because of the social distancing protocol, the ES teaches grade 8 and 9 as well. ES B teaches grade 11. The ES's themselves showed less exposure to different teaching strategies. Therefore, not only the teachers but education specialists as well have challenges with regard to teaching strategies. Both education specialists showed that they do understand what learner-centred and cooperative learning mean in their responses and there were no clear explanations of how the education specialists promote those in their departments. The finding from this aspect reflects that education specialists have insight of different teaching strategies but they are less interested in promoting and monitoring the implementation of teaching strategies by teachers under their supervision.

- **Availability and utilization of ICT resources**

The participants were requested to indicate the ICT resources which their schools have for the advancement of the teaching and learning of mathematics and whether or not do teachers use these resources. The education specialists' responses were structured as follows:

*ES A: "Uhm…we don't have, we have nothing".*

*ES 'B': "Currently we don't have ICT resources, we only rely on our personal laptops to print some materials that can assist us like question papers from other provinces".*

The responses of the education specialists reflected that schools have not yet incorporated technology in the teaching of mathematics. The education specialists are not even aware of the resources in their schools that would assist teachers in the teaching of mathematics; needless to mention monitoring utilization of these resources. Education specialist A is not aware that there are two data projectors and an interactive board at the school. As an MST grant school, school A was expected to be advanced in the utilization of technology in the teaching of mathematics but nothing has been done so far with the available resources. Education specialist B indicated that they do not have ICT resources but with further engagement, he indicated that they have a data projector which teachers sometimes use in teaching

mathematics. The education specialists are correctly placed by virtue of their employment positions to advocate for the procurement of resources which are required in their departments for the advancement of quality teaching and learning. However, the indication is that they do not encourage teachers to utilize the little available ICT resources for teaching.

The interaction with the education specialists on the above aspect revealed that schools have ICT resources there is minimal or no utilization of these resources in the teaching of mathematics.

- **Teachers' support from Subject Advisors**

The question sought to find out if education specialists were aware of the support teachers receive from subject advisors, education specialist A indicated that teachers received support from subject advisors on a quarterly basis. However, the support concentrated on tracking content coverage and the provision of additional resources, with little or nothing done to support teachers on lesson presentations and teaching strategies. This is what education specialist B said in his response to the question:

*" …at times it's once per semester, but this year I haven't seen mathematics Subject Advisor for GET, last year they did support us. Maybe it is because of Covid-19"*

This is an indication of the scarcity of support received from subject advisors in school B. The interaction on the above subject revealed that support from subject advisors does not give attention to teaching strategies, but only on content coverage and development of the mastery of content. It is important to indicate that where there is support in the mathematics department at a school level in terms of lesson study and modelling of different teaching strategies, there is quality teaching and learning even with limited support from subject advisors.

- **Teachers and learners' attitude towards mathematics**

The participants were requested to reflect on the attitude of both teachers and learners towards mathematics. The education specialists' responses were as follows:

*ES A: "Yhaaa… those that I have seen so far, their attitude is good towards mathematics, they are good. Eeeh…I only experience problems with learners,*

*learners no, they don't like mathematics at all. Some believe that mathematics is difficult, that is why they dislike it"*

*ES B: "It's positive towards the subject, for both teachers and learners. When I check with the learners we have, they have improved in terms of the liking of mathematics. They seem to enjoy mathematics".*

The inputs of the education specialists revealed that the manner of lesson presentation has an effect on the attitude of the learners towards the subject; either positive or negative. At school A where the teacher prefers the telling method as the only teaching strategy, the education specialist observed that learners do not like mathematics as they believe that mathematics is difficult. A different scenario is presented in a school where multiple strategies of teaching are preferred. In school B where the teacher uses multiple teaching techniques, the education specialist observed improvement in the attitude of the learners towards mathematics. The education specialist noticed that not only do the learners like mathematics, but they seem to be enjoying it.

### 4.3.3 Interviews with principals

The interview process with principals focused on the following factors:

***Resources for the advancement of mathematics teaching***

The question asked here sought to check if teachers responsible for mathematics were qualified to teach the subject. Both principals confirmed that Grade 9 mathematics teachers were qualified to teach the subject.

What emerged from the interaction on this aspect is that the mathematics teachers have the requisite qualifications for the teaching of the subject. Another finding is that teachers and learners have enough LTSM which include ATPs, textbooks, workbooks, mathematical instruments, and study guides. Another finding is that schools have ICT resources including TV screens, data projectors, smart boards or interactive boards, and video lesson but there was no evidence to confirm that they use these resources.

***Development and support for mathematics teachers and supervision of curriculum management.***

The participants were requested to explain the development and support programs which are provided to mathematics teachers from all levels. I was also interested in finding out if principals do supervise curriculum management by SMT members. The principal responded as follows:

*Principal A: teachers are given the M+1 support which is organised by the department and workshops by the SMT. Also, school-based teachers are being workshopped by the ES"*

*Principal B: "At a school level, they are supported mostly by their ES's because they are specialists in those subjects, they do check their learners' work, they analyse the learner performance, they do class visits, and they do lesson studies where they meet as department and discuss topics and share information".*

The responses of the principals from both schools revealed that mathematics teachers do receive development and support from all levels of the department; starting from the schools to the province. In school B, subject advisors conducted lesson observations while school A indicated that school observations were conducted some time ago. Evidence showed that it was only in school B where teachers engaged in lesson study; where a teacher modelled lesson presentation to develop others on teaching strategies. Furthermore, teachers engaged in team teaching and outsourcing teachers from other schools to come and teach certain topics.

When the participants were asked how often the education specialists conducted class visits and the number of departmental meetings held, this is what they said in response:

*Principal A: "Class visits are done quarterly and departmental meetings are done every month".*

*Principal B: "Departmental meetings are held once per month, and then the class visit is once per quarter"*

The responses of the principals paint a good picture about the practices of the education specialists in the mathematics departments. The responses revealed that what the principals said is the set standard of operation but not the reality. Minutes of

meetings told a different story that departmental meetings are scarcely held and the agendas are not really addressing challenges experienced in the department. The instrument for class visits does not tell a clear story of what happens during lesson presentation because there are ticks in all the boxes without any comments. The instruments show a trend of doing it for compliance. Both principals indicated that one-on-one meetings are held as a follow-up to findings however, minutes of the se meeting are silent on matters of curriculum development but more vocal on behavioural development.

School principals are aware of the set standard or responsibilities of their SMT members but there is little or no supervision of curriculum management by school management teams. Existing evidence shows that principals operate on the basis of trust with their SMT members and little or nothing is done to monitor and develop them to be effective in their areas of management.

*Grade 9 mathematics performance and factors affecting performance*

Principals were requested to share the Grade 9 mathematics performances in their schools and to indicate factors that affect performance. This is what they said in response:

*Principal A: "It is not good".*

*Principal B: "It is very poor in Grade 9".*

Principals further shared other factors which affect learner performance in mathematics in their schools and this is what they said:

*Principal A: "I think the basis from the basic primary level learners did not get the basics. So, to continue with them, teachers need to start with the basics"*

*Principal B: "Learners lack basic concepts in maths…number two I think is the attitude, learners would already know that maths is difficult"*

Both principals pointed out that there are gaps in the mastery of concepts from the foundation laid in the lower grades which affect the performance of learners in mathematics in Grade 9. Principal B further elaborated that the attitude of learners is negative towards mathematics as they consider it to be difficult, therefore their

attitude affects their performance negatively. Discipline was also cited as one element that affects performance in mathematics because at Grade 9, learners enter into the adolescent stage and they start to experience peer pressure which affects the discipline and hard work that is needed for them to do well in mathematics. The findings above confirm that performance in mathematics is not good in both schools although school B' registered a high pass percentage in 2019 in Grade 9. This contradiction will be clarified in the analysis of documents later in this chapter. Secondly, this part of the study established that attitude has an effect on learner performance and that poor learner discipline is a contributory factor to performance in mathematics.

***Ways and means to advance good teaching for improved performance in mathematics***

Principals were requested to reflect on their experiences and observations and to suggest initiatives of how teachers and learners may be assisted to enjoy mathematics. In their responses, a list if initiatives were suggested including the following:

- In-service training for mathematics teachers;
- Fantasizing mathematics teaching and learning by using smart boards and tablets;
- Peer teaching by learners;
- Differentiated learning.
- Regular support by subject advisors;
- Incentives for mathematics teachers as it is done in FET;
- Introduction of projects and competitions in mathematics as it is done in Science where there is Science Olympiad;
- Availability of mathematics teachers (specialists); and
- Games and debates in mathematics.

This study revealed that those principals have good and pragmatic ideas of what needs to be done to improve the interest and performance of learners in mathematics. However, there seems to be little or no will power to operationalize these ideas; more specially those which are economically viable at school level.

### 4.3.4 Interview with Subject Advisor

The interviews with the Subject Advisor focused on the following:

*Development and support programs for mathematics teachers*

The question that was asked set out to find insight on the role of the subject advisor at the school level as well as to check the support and development programs which are provided for teachers. The participant posited that his roles included the provision of curriculum support for teachers, monitoring the implementation of curriculum and capacity building through classroom observations. The subject advisor further presented that he conducts content workshops, mathematics laboratory workshops and digital training. Concerning class visits for lesson observation, the participant indicated that he conducts lesson observations. He also indicated that he liked cooperative teaching and ICT based teaching. This is what he said:

*"I like cooperative teaching and ICT but most teachers are computer illiterate".*

The responses of the subject advisor revealed that he is conversant with his roles and responsibilities. While the subject advisor provides support to schools, available evidence revealed that not all teachers were privileged to benefit from all the support and development programs which were enlisted due to dearth of school visits. When asked about how he assists teachers with the choice of appropriate teaching strategies, the subject advisor responded as follows:

*"We discuss teaching strategies after lesson observation, we feedback on teaching strategies and give templates of lesson plans".*

The participant's response indicates that a discussion about teaching strategies does happen after every lesson observation. Due to the shortage of subject advisors in the district, the frequency of visits to schools is at most twice in a year. This suggests that not all visits focus on lesson observations. The finding here is that discussions about teaching strategies between the subject advisor and teachers happen occasionally but there is dearth of evidence to substantiate that teachers receive assistance on the choice of appropriate, content specific teaching strategies.

*Resources for the advancement of mathematics teaching*

The question here sought to find out if teachers have enough and relevant LTSM for teaching mathematics. The response was as follows:

*"They don't have, no enough textbooks, no ICT resources".*

The participant clarified that there was lack of relevant LTSM where learners share textbooks in some instances. He further elaborated that performance in mathematics would improve if school had mathematics laboratories but unfortunately; only 29 schools in the entire district have the facility. Lack of internet connectivity, interactive boards, computers and tablets for mathematics teaching, coupled with lack of digital skills among teachers aggravate the challenges in the teaching of mathematics.

This aspect revealed that there are no relevant and adequate resources in schools for the teaching and learning of mathematics. Teachers who are skilled in using technology in teaching mathematics are limited by lack or shortage of ICT resources; including internet connectivity. Some schools, very few though, received ICT resources including tablets, computers, interactive boards and mathematics laboratories but these resources are not maximally utilized due to skills shortage among teachers.

## 4.4 RESULTS FROM DOCUMENTS

### 4.4.1 Analysis of Grade 9 mathematics results

The performance of learners in mathematics in the participating schools is generally not good. Schools were sampled based on their performances to represent good and poor performance. The results for the past three years were provided earlier in this chapter and my analysis focused on the 2019 results where school A registered 2.9% pass and 92% for school B.

The analysis of the documents revealed that though school B presented a glossy pass percentage, the quality of the results in terms of performance levels was not good. Out of 106 learners, 8 performed at level 1 whereas all 98 learners were at level 3. This represents a bunching of marks which could be the result of marks adjustment or standardization. This suggests that the majority of learners were at level 2 and they were pushed to level 3 (which is a pass requirement) through the adjustment of marks. In school B, out of the 202 learners, only 6 learners managed

level 3. The conclusion that can be drawn from the two schools is that their difference in performance is basically on quantity and not quality.

### 4.4.2 Monitoring instruments

The mandatory instruments used by education specialists for monitoring teachers' work in the district concentrate on matters including availability and quality of lesson plans, compliance with the ATP, availability of textbooks and assessment. The lesson observation instruments used by the participating schools were different in terms of structure, but all of them they are designed to check lesson preparation and presentation as well as assessment. The lesson presentation part in the school A tool monitors learners' participation, selected teaching methodology and the relevance of the selected resources and teaching aids. The presentation part for the school B tool enquires on learners' participation among others. The finding of this section is that the intention of the lesson observation instrument for education specialists in school A is to develop and support teachers on a number of areas; including the selection of relevant teaching strategies as well as the selection of resources and teaching aids. There is, however, little or no evidence of lesson observations being conducted quarterly. Records confirm one lesson observation per annum.

### 4.4.3 Minutes of departmental and one-on-one meetings

The analysed documents revealed that principals conduct one-on-one meetings with all members of staff; inclusive of teaching and non-teaching staff and unions on site. However, the minutes revealed that discussions with the teaching staff were basically on behavioural challenges such as late coming, leave matters and interpersonal relations. Departmental meetings should be held at least once a month as a set standard; but minutes revealed that they are held once per term in most instances. Furthermore, the minutes of these meetings from the participating schools reflect discussions around the analysis of results, allocation of teaching subjects, and tracking of content coverage. The findings of this section suggest that departmental and one-on-one meetings do not address the issues of the development of teachers

on the choice of teaching strategies and the provision of resources towards improving the teaching of mathematics.

### 4.4.4 Log books entries

Log book entries revealed that subject advisors record the purpose of their visits to the school, findings of their monitoring as well as recommendations. The finding from the log book entries is that the purposes of the visits by subject advisors in most cases focus on curriculum resource provisioning (ATP's, study guides, common assessment tasks, and previous question papers), tracking of content coverage, and assessment moderation.

## 4.5 RESULTS FROM OBSERVATION

Observation in the participating schools focused on the following factors:

### 4.5.1 Lessons observation

My lesson observation protocol focused on the following aspects:

- Learners sitting arrangement in the classroom;
- Introduction of the lesson (activation of prior knowledge);
- Teaching resources/ teaching aids (taking real objects to class);
- Teaching strategies and learners' participation; and
- Classroom environment (resources and classroom walls)

In school A learners were arranged in rows and in observance of the Covid-19 regulations of 1,5m apart. The class was generally clean and well ventilated. However, the only resources in the classroom were learners' furniture and the chalkboard. The class walls had the Covid-19 posters, class time table and class rules only. The lesson which I observed was about fractions. The teacher brought pieces of chalk, handouts (copied one page from the textbook) and a textbook to class. The lesson was introduced by distributing hand-outs; followed by questions to establish the prior knowledge of the learners about fractions. The teacher repeated the question several times without getting a response from the learners. The learners were quiet and finally, very few learners participated in giving responses. The

behaviour of the teacher and the learners suggests the following trends in the teaching of mathematics in school A:

- The teacher uses the traditional teaching style where knowledge is transferred from the teacher to learners through the telling method. The teachers used the question and answer method only for teaching and as such, there was no fantasy involved in the teaching of fractions as the lesson was teacher-centred and the learners were passively fed with information;
- The teacher r uses the chalkboard and chalk during guided practice where he does an activity on the chalkboard while the learners participate in providing answers. The examples were erased immediately thereafter to allow space for other writings and the learners were deprived an opportunity of reference during independent practice;
- No attempts were made by the teachers to create a practical learning environment by taking real objects to class. For example, to illustrate how a whole object could be divided into portions (fractions), only simple free hand drawings were made on the board;
- The participation of the learners in the lesson is limited to answering questions and to indicate if they have understood or not. The class atmosphere was rigid and formal with learners displaying less self-esteem than in school B;
- Underutilization of classroom walls for pasting subject related posters; and
- Non-utilization of technology in teaching.

The sitting arrangement was the same in school B to ensure compliance with Covid-19 regulations and protocols. The classroom was clean and well ventilated. The classroom set-up was similar to that of school A; with learners' furniture, a chalkboard, Covid-19 message posters and a class timetable on the wall. The teacher brought a 1m ruler, textbook and pieces of chalk to class. The introduction of the lesson was marking of homework where activities were done on the chalkboard and learners marking their own work.

The activities of the teachers in the above scenarios suggested the following trends in the teaching of mathematics in school B:

- The teacher used a combination of telling, question and answer, as well as peer teaching strategies. The learners took turns to plot graphs on the chalk board while explaining why the dots were put on the x and y axis;
- Dependence on the chalkboard as the only teaching aid and examples were erased immediately as in school A;
- The participation of the learners included answering questions and demonstrating understanding of the learning content by sharing the teaching platform with the teacher. The atmosphere in classroom was characterised by relaxation and freedom among learners;
- Underutilization of the classroom walls to create a lively learning environment by hanging subject related posters; and
- Non-utilization of technology in teaching.

### 4.5.2 School culture

The participating schools displayed different ways of doing things in general; which can be referred to as school culture. School A is a big school with a learner enrolment of above 1300 and more that 50 staff members, inclusive of teaching and non-teaching staff. The staff compliment suggests that there could be a considerable number of teachers teaching a particular subject across all grades. However, the findings of this study suggest that there is less or no team work among the teachers in the mathematics department. Learner discipline is also a challenge as there are cases of learners bunking classes, absenteeism and late coming. The school culture in school B is characterised by fewer challenges of learner discipline. The finding from the school A scenario revealed teamwork among mathematics teachers; evident in lesson study and team teaching as well as engaging teachers from other schools (outsourcing). However, school B is a small school with a learner enrolment of 450 learners and a staff compliment of 20; inclusive of teaching and non-teaching staff.

The finding that can be drawn from the above is that school culture has an effect on the general functionality and academic performance of a school.

## 4.6 THEMES THAT EMERGED FROM THE INTERVIEWS, OBSERVATIONS AND DOCUMENT ANALYSIS

The table below represents the themes that emerged from the responses of the participants in the interviews, the observations and the analysis of the different documents. Each of these themes will be discussed in details in the following chapter.

| NO | THEME DESCRIPTORS | SOURCE |
|---|---|---|
| 1 | Strategies used in the teaching of mathematics in Grade 9 | The title (subject matter) of the study. |
| 2 | There is no guidance on the choice and usage of teaching strategies (single versus multiple strategies) | Specific strategies, LTSM and resources used to teach mathematics. |
| 3 | Teachers receive minimal development from education specialists and subject advisors | Teacher development, monitoring and support. |
| 4 | The manner of lesson presentation has an effect on the attitude of learners and teachers towards mathematics. | Teachers and learners' attitude towards mathematics. |

## 4.7 CONCLUSION

This chapter discussed the findings of the study based in data collected through the interviews, observations and the analysis of document and artefacts. The following chapter will present the summary of the research findings and their implications

# CHAPTER 5

# DISCUSSION OF THE FINDINGS, RECOMMENDATIONS AND CONCLUSION

## 5.1 INTRODUCTION

The previous chapter presented the findings of this study. This qualitative case study sought to explore the different teaching strategies which mathematics teachers use to teach mathematics in order to uncover alternative and appropriate strategies for better mathematics performance for Grade 9 learners in Mkhuhlu Circuit, Bohlabela District in the Mpumalanga Province. Data for this study was drawn from two secondary schools which represented good and poor mathematics performances, using semi-structured interviews, observations and documents analysis. This chapter set out to discuss the findings. The chapter commences with the presentation of the summary of results and the discussion of individual themes. There are sections of the chapter that will discuss the implications of the study for teachers, SMT and SGB, as well as education authorities with regard to mathematics teaching and learning. Finally, the limitations of the study and some recommendations for future research are also presented.

## 5.2 SUMMARY OF THE RESULTS

The general findings of this study are firstly, that teachers in Mkhuhlu Crcuit use both traditional (teacher-centred) and participatory (learner-centred) teaching strategies in the teaching of mathematics. Secondly, the availability of resources including ICT determines the choice of teaching strategies. Thirdly, curriculum management practices of principals and education specialists have an effect on the quality of teaching and learning. Fourthly, that using a single teaching strategy was linked to learners' negative attitude towards mathematics and low levels of learner performance. Finally, a variation and combination of teaching strategies was linked to Grade 9 learners having a positive attitude and better performance in mathematics. The findings are represented by the following themes:

Major theme- Strategies used in the teaching of mathematics in Grade 9.

Sub-theme 1- There is no guidance on the choice and usage of teaching strategies (single versus multiple teaching strategies)

Sub-theme 2- Teachers receive minimal development from education specialists and subject advisors.

Sub-theme 3- The manner of lesson presentation has an effect on the attitude of learners towards mathematics.

## 5.3 DISCUSSION OF INDIVIDUAL THEMES

The findings of this study are clearer when we focus the discussion of individual themes in some detail.

### 5.3.1 Theme 1: Strategies employed in the teaching of Grade 9 mathematics

This theme is divided into three main ideas namely, the teachers' knowledge about teaching strategies; the strategies used by teachers in the teaching of mathematics and lastly, the gaps in the different strategies used.

*Teachers' knowledge about teaching strategies*

It emerged from the analysis of data that teachers have fair knowledge of teaching strategies to be used in the teaching of mathematics in Grade 9. This study revealed that teachers are aware of the traditional and participatory teaching strategies but different factors were instrumental in the teachers' choices and preferences of the teaching strategies they used. These factors include lack of skills and exposure to different teaching strategies. Other factors include the shortage of relevant resources to support the use of teaching strategies, and the learners' preferences of and response to the teaching strategies used. The knowledge of the teachers about teaching strategies became evident through their responses when they were requested to provide their versions and understanding of learner-centred and cooperative learning. Both teacher A and B indicated that they engaged their learners in cooperative and learner- centred teaching but there was lack of evidence to support teacher 'A's assertion.

My observation is that teachers in school A were reluctant to use cooperative learning despite their awareness of it and its indispensability in the teaching of mathematics. This finding is consistent with other findings elsewhere. For example,

Dignath and Büttner (2018) found that there is reluctance on the part of teachers to promote cooperative learning. This finding is against what Brumbaugh and Rock (2011) advocated in their book titled Teaching Secondary Mathematics; that teacher should emphasize learner-centred teaching. However, there was enough evidence to support that teacher B used and showed passion in cooperative learning and learner-centred teaching than teacher A, who preferred the question and answer method. Teacher B indicated that he involves group work and presentations by learners as well as peer teaching among learners themselves. Alabekee, Samuel and Osaat (2015) opined that cooperative learning is the use of small groups when teaching in a manner that enables learners to work together towards a common goal. Strategies that enable learning through group interaction encourage communication, sharing of ideas, arguments that are required for learning and the development of individual learner (Ciobanu, 2018). This approach to teaching and learning presents an opportunity for learners to engage productively with each other, where there is mutual assistance and collaboration (Ciobanu, 2018)

Learners assume an active role in their knowledge construction instead of passively receiving information from the teacher. This is in line with the constructivist theory of teaching and learning which promotes a participatory approach wherein learners participate actively in the learning process (Fernando & Marikar, 2017). It is the tenant of constructivism that learners must be involved and be fully accountable for the strides achieved in their knowledge construction (Ciobanu, 2018). The teacher therefore, in possession of subject content expertise, assumes a facilitator role for the enhancement of greater learning experience by the learners. Research found that teachers preferred cooperative learning in the teaching of mathematics because it promoted interaction between learners and teachers as well as with their peers, and for the provision of permanent learning (Ünal, 2017). Alabekee, et. al (2015) amplified that it is an effective and interesting teaching strategy which yields significant learning gains.

However, Ünal (2017) clarified that the cooperative learning strategy, though preferred by teachers for simplifying the learning process, was criticised for limitations in terms of time consumption. Furthermore, it requires thorough preparation and the help of ICT resources for robust communication between team members (Djenic & Mitic, 2017). It becomes imperative for teachers to ensure

availability of resources and time when they consider cooperative learning for it to be effective. Reflecting on the performance of the learners in school B, cooperative learning emerged as an effective teaching strategy. The effectiveness of this strategy is linked to the learners' positive academic achievement in mathematics. The results of this study are inconsistent with a study by Alabekee, et al, (2015) which revealed that learners taught through the cooperative learning strategy performed better in mathematics. It was also found by Boyd and Ash (2018) that the use of cooperative learning with the support of concrete objects was the reason for good performance in mathematics in Singapore.

*Teachers' preferences of teaching strategies*

An analysis of the data revealed that teachers preferred the question and answer teaching strategy in the teaching of mathematics. This was reflected in teacher A's response when she indicated that the question and answer method works best because that she used it throughout the year. The question and answer method was also emphasized by teacher B as one of the teaching strategies he prefers. It appeared that both teachers preferred the question and answer strategy for classroom instruction. In his study of the titled '*Preferences of Teaching Methods and Techniques in Mathematics with Reason',* Ulna (2017) also discovered that most teachers preferred the question and answer strategy in the teaching of mathematics. The reason that the teachers gave for their preference is that the question and answer strategy does not demand more effort and preparation (Ünal, 2017). Teacher A, on the other hand, submitted that this teaching strategy captures the attention of the learners and provokes them to listen and think. It becomes clear that the question and answer method is a participatory teaching strategy that supports the involvement of the learners in their learning as espoused by constructivism.

Research confirmed that one of the advantages enjoyed by South Korea towards good academic performance in mathematics was access to teachers with more advanced teaching skills (van der Grift, el al, 2017). On the contrary, this study revealed that teacher A lacked skills to use the question and answer strategy effectively. It also emerged that the question and answer method eventually changed into the telling or lecture method when learners were not participating in the classroom discussions or activities. This was picked up from teacher A's expression

when she indicated that when the learners did not know the answer to a question, they usually keep quiet. It is important to note that even though teacher A was keen to use the question and answer strategy of teaching, lesson observation revealed that the teacher used the telling strategy for lesson delivery. The telling strategy involves an attempt to impart knowledge to learners through the medium of speech (Fernando & Marikar, 2017). It is a traditional teaching strategy where the learners are limited to be knowledge recipients while the teacher does the talking and writing on the chalkboard.

Namitha (2018) referred to this teaching approach as the chalk-and-talk strategy where there is one-way flow of information and the lesson is teacher-centred. The traditional method of teaching limits the participation of the learners. The teacher often talks for a long time without involving the learners and there is insufficient interaction during the lesson presentation (Namitha, 2018). Even though it is credited for its viability to enable a lot of content coverage in a short space of time, the telling method yields shallow and poor-quality learning which is temporary (Fernando & Marikar, 2017). Research established that passive teaching strategies appeared to be detrimental as they lead to failure to understand concepts by learners (Hsieh, Wang, & Chen, 2020; Mupa, 2015). Boyd and Ash (2018) on the other hand, found that there were positive learning gains for mathematics if the telling method was used with the support of content rich textbooks. Research conducted by Awofala and Lawani (2020) in Nigeria found that lack of diversity in teaching and dependency on the traditional telling teaching strategy was the cause of poor performance in mathematics. (Awofala & Lawani, 2020).

Drawing from the research cited above, it becomes clear that the question and answer teaching strategy requires skill for it to be participatory; otherwise it changes to the traditional telling strategy which is teacher-centred. Research suggests that in order to reap positive learning gains from the telling method, it requires support of other resources such as content rich textbooks, diagrams and pictures or it must be used together with participatory strategies for it to be effective (Fernand & Marikar, 2017). Research revealed that underperformance by majority of learners is basically linked to teachers using ineffective teaching strategies to impart knowledge (Gengle, Abel, & Mohammed, 2017; Adunola, 2011; Ogbeba, 2010). Taping into the top performing countries in mathematics, research found that the traditional telling or

lecture teaching strategy yielded good learning gains when used together with good textbooks and concrete objects in Singapore (Boyd & Ash, 2018), more advanced teaching skills and the use of technology in South Korea (van der Grift, et al, 2017; van der Wal & Jojo, 2014).

The analysis of documents in School A revealed poor performance of learners in mathematics. Based on the above account, the poor performance of the learners may be ascribed to the teachers using a single and undiversified teaching strategy. It appeared from the analysis of data that using a single teaching strategy impedes quality teaching and learning. Teachers tend to be frustrated when they are conversant with and use only one strategy in the teaching of mathematics. As teacher A indicated that when there was an expression that learners did not understand, her only option was to start all over again and re-teach. This repetition is a result of reliance on one strategy to impart knowledge to the learners. In line with this thinking, Okwudula and Okigbo (2018) in their study of 'the effect of teaching methods on students' academic performance in chemistry' found that using of one teaching strategy is ineffective for the improvement of the performance of learners. Using a combination and variation of teaching strategies is crucial in teaching to reach out to the diverse needs of the learners and to ensure that their learning needs are met (Wesonga &Aura, 2019; Yawman & Kubi, 2018; Brumbaugh & Rock, 2011) ; Brumbaugh & Rock, 2011).

It is important for teachers to expand their knowledge of various teaching strategies and apply as many of them as possible to circumvent repetitions that devalue their teaching (Chiobanu, 2018; Ganyaupfu, 2013). Using a variety of teaching strategies will capture learners' attention and keep them motivated and fully engaged throughout the lesson. School B presented a different picture regarding the use of teaching strategies in teaching mathematics. Teacher B indicated that he uses multiple strategies to teach. He also indicated that learners are given an opportunity to make presentations of their group work, a task which is highly participatory and helps to build their self -confidence. My observations revealed that learners share the front space with the teacher and engage in peer teaching. Teacher B also confirmed using teachers from other schools to assist with specific topics as one of his strategies. This is evident that teacher B has a diversified approach in the teaching of mathematics.

This is in line with an assertion by Yawman and Kubi (2018); Hsieh, Wang and Chen (2020) that active participation and involvement of learners can only be achieved through a variety of innovative teaching and learning strategies such as peer tutoring, team teaching, cooperative, discovery and experiential learning. The findings of this study suggest that the use of multiple teaching strategies supports quality teaching and learning in mathematics, and is linked with improved learner performance as is the case in school B. This finding is consistent with other findings that when traditional teaching strategies are mixed with participatory strategies like question and answer and group discussions, they yield desirable outcomes in learner achievements (Bosman & Schulze, 2018; Okwuduba & Okigbo, 2018; Fernando & Marikar, 2017; Habibi, Kuswanto, & Yanti, 2017). Learners are different and even their learning strategies are not the same; so, teachers need to consider that one teaching strategy cannot be a 'one size fits all'. Teachers must know both mathematics as a subject and the learners they teach; and be considerate in the choice of their teaching strategies (Kim, 2020; Claven, Crespo, & Me'ndez, 2016).

*Gaps of the teaching strategies used*

In contrast with Chiobanu's finding that teaching methods in European schools are nowadays the most interactive, participatory and collaborative, student-cantered and not teacher-centred (Chiobanu, 2018), this study revealed that even non-participatory traditional teaching strategies are used in the teaching of mathematics. The trend that was picked up is that teacher A used the traditional teaching style where knowledge is transferred from the teacher to the learners. Using the question and answer method during teaching, which ultimately translated to the telling method due to non-participation of learners was also noticed. There was no fantasy involved in the teaching of fractions. The lesson was teacher-centred and the teacher relied mostly on the chalkboard and chalk. No attempts were made by the teachers to create a practical learning environment by taking real objects to class. The participation of learners in the lesson was limited to answering questions and to indicate if they have understood the learning or not. The class atmosphere was rigid and formal; learners displayed lesser self-esteem. This observed trend and teaching technique corroborates Namitha's findings concerning the traditional teaching strategy (Namitha, 2018).

Namitha (2018) recorded the following gaps in the traditional and teacher-centred teaching strategies: classroom teaching is a one way flow of information by relying on the chalk and talk style where the teacher is a transmitter and learners are receivers; interaction between the teacher and learners is inadequate and the teacher often talks for a long time without checking if the learners understand the taught content, learning is based on memorization and not understanding thus making teaching a theoretical exercise and not an exercise of creating knowledge in a practical and real-life environment. There is minimal involvement of learners by the teacher when using the traditional teaching strategy; and there is absolutely no social interaction for knowledge development among the learners. The tenet of social constructivism is the construction of knowledge and understanding through social interaction. The interaction between the teacher and the learner and between learners themselves is crucial for the construction of quality knowledge. Teachers should ensure that a classroom serves as a place where knowledge development is fostered and nurtured (Brumnaugh & Rock, 2011).

This study established that teacher B used a combination of teaching strategies which included question and answer, telling method, cooperative learning, peer teaching as well as team teaching or collegiality. Learners were actively involved in the lesson and not passive recipients of information. The participation of learners included answering questions and demonstrating their understanding of the learning content by sharing the teaching platform with the teacher. The atmosphere in the classroom was characterised by relaxation and freedom among learners. The teacher used a variation of traditional teacher-centred as well as participatory learner-centred teaching strategies. The teacher's practice is in line with the constructivist teaching and learning theory which advocates a participatory technique in which learners actively participate in the learning process. As much as the grey areas of the traditional teaching strategies have been outlined above, Djenic and Mitic (2017) opined that considering teaching strategies, we cannot generalize the advantages of one over the other. Participatory teaching strategies do have challenges and gaps as well.

Similarly, it is worth noting that every teaching strategy has both strengths and weaknesses, advantages and disadvantages (Lwin & Oo, 2020). With specific reference to group discussion, project and discovery teaching and learning

strategies, Lwin and Oo (2020) enlisted the following as disadvantages: the strategies are time consuming; which requires the teacher to carefully manage classroom conditions, participatory strategies need proper organisation and provision of teaching aids to present learners with an opportunity to understand the learning content; and the success of these strategies is depended on the teacher's ability to encourage and motivate learners to participate in the learning activity. Chiobanu (2018) added that participatory teaching strategies are more tiring for the participants unlike the traditional ones that are more passive and relaxing on the part of the learners. Another challenge with participatory teaching and learning strategies, particularly team work or cooperative learning is that learners tend to relax and derail their focus immediately after their reporting task and pay less attention to other teams' presentations. This practice impedes learning because the idea behind this strategy is that learners should learn from others' ideas and perspectives of the learning content.

Based on the above discourse, a combination of traditional and participatory teaching strategies is supported.

### 5.3.2 Sub-theme 1: Resources used in the teaching of mathematics [theme descriptor: there is no guidance on the choice of and usage of teaching strategies]

Based on the literature about the various aspects and meaning of the term strategy, Ocasio and Joseph (2018); Freedman (2013) asserted that strategy involves the setting of goals, determination of actions to be undertaken as well as organizing the necessary resources towards the achievement of the set goals. Owens (2007) added that for a strategy to be practical, issues of technology and geopolitical realities should be considered over and above the availability of resources. The cited literature suggests that there is no strategy without resources and that the viability of any strategy is anchored on the availability of resources. In the field of educati on, a teaching strategy is a combination of a teacher's educational behaviour together with the use of available resources geared towards goal achievement (Rahayu & Siregar, 2018). On that note, it suggests that the teacher's teaching style may not translate into a teaching strategy without the consideration of the resources. and the teaching of mathematics cannot be an exception. In education, teaching and learning depend on the use of teaching strategies which include the teacher's style of teaching

together with the learning and teaching support materials (LTSM) to have desirable and envisaged academic outcomes.

This study revealed that there is no guidance for mathematics teachers on the choice and utilisation of teaching strategies. It is left to the creativity of the teacher to plan and arrange teaching and learning support materials for the enhancement of quality teaching and learning. However, it appeared that teachers completely underutilised the class walls to build an atmosphere that is inviting for mathematics learning through visuals that foster self-learning. Teachers showed inadequacy in the creation of a stimulating and effective mathematics learning environment in their classrooms. Classrooms must be designed in a manner that nurturers and fosters knowledge development (Brumbaugh & Rock, 2011). Again, Brumbaugh and Rock (2011); Bosman and Schulze (2018) emphasized that teachers must create surroundings which are rich with exposures that support learners to make sense of mathematics. There is a number of teaching aids which mathematics teachers may improvise and paste on the walls like multiplication tables, drawings of different angles and their names, different shapes, graphs, fractions, to mention a just few. These teaching aids would support learners' self-learning and self-discovery as constructivism advocates.

This study that the LTSM available for mathematics teachers and learners include annual teaching plans (ATP's), textbooks, workbooks, exercise books, mathematical instruments, study guides, as well as Information and Communication Technology (ICT) resources such as TV screens, tablets, laptops, data projectors, smart boards or interactive boards and video lessons. The data indicated that there was a shortage of ICT resources in schools as postulated by teacher A when she indicated their reliance on the subject specialist's laptop as a department, a gadget which the specialist also relies on. Teacher A also indicated that they had two data projectors but it was not possible for them to use the projectors without a laptop. This finding is supported by other research findings that there were challenges regarding teachers using ICT for teaching and learning due to unavailability or low levels of availability of technological resources in schools (Galina, 2019; Ostrowick, 2019; Safdar, Yousof, Parveen, & Behlol, 2011). Researchalso reported that school stakeholders feel that ICT is the least priority to spend money on than textbooks, electricity, basic infrastructure and so on (Ostrowick, 2019).

There was an indication that teachers use paper-based resources such as ATPs, textbooks, workbooks and exercise books. However, there was neither indication nor evidence of the usage of the few available ICT resources in the teaching and learning of mathematics as indicated by teacher B when he confirmed that he has never used ICT. Kubiatko (2017) reported that teachers were not using the whiteboard because they did not know the advantages and disadvantages as well as how to use it. Ostrowick (2019) asserted that teachers were were not trained on how to use ICT and they did not have the requisite knowledge and skills for effective incorporation of ICT in classroom teaching. Lack of knowledge and interest by teachers on ICT was also reported (Safdar et al, 2019). Research also reported that age had an effect on the confidence and interest of teachers to use ICT. Galina (2019) reported that teachers above the age of 50 had challenges in learning to operate the interactive whiteboard. It was also reported by Safdar et al (2019) that old people think that they don't need ICT because they spent most of their years without it. Mathematics teachers in both school 'A and B were all within the age bracket of 41 and above and considering Galina's argument concerning age, the teachers' inability to use ICT could be linked to the age factor.

In contrast to the finding that there is successful utilisation of ICT in developed countries (Safdar et al, 2011), this study revealed that there is minimal or no advocacy at the level of schools to promote technology-based teaching. This claim is supported by the fact that the mathematics subject specialists in both schools were not aware of the available ICT resources at their schools and this is evident in how they responded when they were asked which ICT resources they had access to at their schools. The responses of the teachers are an indication that ICT is the least prioritized for teaching and learning in schools. This is supported by Ostrowick (2019) who reported that ever since the publication of the White Paper on e-Education in 2004, the Department of Basic Education has been struggling to introduce ICT in teaching and learning due to low levels of e-readiness by schools as well as limited IT and human resource capacity. Meanwhile, it is impossible to have effective ICT teaching without equipped teachers (Galina, 2019). As long as teachers are disempowered and feel inadequately skilled; more especially in rural areas where access to ICT is a challenge (Ostriwick, 2019), teaching and learning through ICT is still far- fetched.

This study that where provision is made for ICT resources, as it is the case in school B, schools fail to use these resources because they are not provided with the necessary training. Research found that teachers' lack of capacity on the use of ICT resources is the cause of failure of attempts to introduce teaching and learning through technology in schools (Galina, 2019; Ostrowick, 2019; Kubiatko, 2017, Safdar et al, 2011). As much as it was a finding that through sufficient provision and capacitation of human resources, ICT was reported effective for academic performance in mathematics (Safdar et al, 2011), the use of ICT remains a prospective solution to effective and productive teaching and learning of mathematics. This study also found that lack of resources for the teaching of mathematics is another factor that limits variation of teaching strategies that ultimately produce undesirable learners' academic performance. The provision of ICT together with other relevant resources for mathematics teaching, as well as capacity building for teachers on the implementation will enable teachers to explore new teaching strategies. Teachers will have a pool of teaching strategies to make choices from; to diversify strategies for quality teaching of mathematics for improved learner performance.

### 5.3.3 Sub-theme 2: Teachers' Development, Monitoring and Support [Theme descriptor: teachers receive minimal development from education specialists and subject advisors]

This study revealed that teachers receive support from HOD's and subject advisors. However, the support is hinged on the mastery of content, the tracking of curriculum coverage, and less on the delivery part of the curriculum. The support ensures the availability of lesson plans but neglects the teaching practices that teachers engage in when presenting their lessons. This finding is inconsistent with what was found by Moshoana and Thaba-Nkadimene (2016) in their study titled: "promoting the culture of teachinhg and learning through effective curriculum management" in Limpopo. They found that the curriculum management practices of principals and other SMT's included the monitoring of curriculum implementation by checking content coverage against the pace setters; written work against subject policies and teachers period attendance for teaching and learning against the teachers' personal time tables. Principals and deputy principals checked the monitoring instruments of the HODs as part of their curriculum management

supervisory role; and reports on curriculum management as evidence of teachers' monitoring and support ( Moshoana & Thaba- Nkadimene, 2016).

Contrary to the finding of this study, Moshoana and Thaba-Nkadimene (2016) found that principals and SMTs paid attention to the teachers' classroom practices. It was recorded that teachers were encouraged and motivated by their principals to adopt learner- centred teaching strategies which promoted learners' participation in the teaching and learning process which lead to sound classroom practices. This research found that sound classroom practices and the provision of adequate and appropriate learning and teaching support materials as well as a bedrock of effective curriculum management by principals and SMTs, worked together for the promotion of quality teaching and learning which resulted in good learners' performance (Moshoana & Thaba-Nkadimene, 2016). The competency of the SMTs in effective curriculum management; together with the provision of subject specialisation by subject advisors is crucial in determining what the teachers and learners are doing in their classrooms.

This study further emphasized that the school level monitoring and support system indisputably have an impact on quality curriculum delivery by teachers (Moshoana & Thaba- Nkadimene, 2016). This study revealed that support from subject advisors does not give attention to teaching strategies but content coverage and the development of content mastery. Again, where there is support within the mathematics department at a school level in terms of lesson study and modelling of different teaching strategies as is the case in school B, there is quality teaching and learning even with limited support from subject advisors. Effective curriculum delivery by teachers cannot be dependent on the support of subject advisors; given that they are few and operating from the district office. The study conducted in Limpopo found that there was a shortage of subject advisors and this compromised curriculum delivery (Moshoana & Thaba- Nkadimene, 2016). The principal and the SMT members have a duty to provide effective and properly planned staff development programs to support teachers towards good classroom instruction through the choice and use of appropriate teaching strategies.

Even though principals indicated their awareness of the set standard or responsibilities of their SMT members, this study revealed that there is little or

shadow supervision of curriculum management by SMTs. Evidence from the analysed documents revealed that principals operate on the basis of trust for their SMTs and little or nothing is done to monitor and develop them to be effective in their areas of management. In support of this finding, principals in Malaysia were found to be good in strategic planning for the improvement of curriculum achievement, but they were found lacking in ensuring that teaching and learning are given priority by teachers (Alias, Zainudin, & Nasri, 2018). Contrary to the finding of this study, Moshoana and Thaba- Nkadimene (2016) found that principals together with their SMTs were monitoring curriculum delivery in schools; giving attention to the teachers' classroom practices and the outcome thereof was improved learner performance. Their study concluded that the effective management of curriculum implementation is a precondition for improved performance of schools and learners because it focuses where it matters most in the school's business; which is teaching and learning. Furthermore, there is a need for the development of the capacity of SMTs on effective curriculum management as well as the creation and sustenance of the culture of teaching and learning in schools for improved learner performance in mathematics.

### 5.3.4 Theme 4: Teachers and learners' attitude towards mathematics [Theme descriptor: the manner of lesson presentation has an effect on the learners towards the subject]

The mathematics HODs indicated that the attitude of learners towards mathematics is not good as reflected by HOD A during the interviews. Teacher A also indicated that learners literally ran away when she requested them for extra classes as a catch-up program for lost teaching and learning time. This finding is inconsistent with a finding recorded by Sinyosi (2015) that some learners have phobia for mathematics and they think the subject is too difficult for them. Sinyosi (2015) further ascribed this fear and hatred of mathematics to passiveness of learners during lessons and recorded that these learners developed a negative attitude towards the subject and presented the following behavioural patterns:

- They did not participate during the lessons and disturbed other learners from paying attention; causing problems of ill- discipline and dent the quality of the lesson.

- These learners absconded and bunked classes; which becomes detrimental towards the effective learning of the subject.

Similar findings were recorded by a study conducted by Mokgwathi, Graham and Fraser (2019) on 'the relationship between Grade 9 teachers' and learners' perceptions and attitudes with their mathematics achievement'. Mokgwathi, et al (2019) found that learners who were less confident dislike and did not value mathematics and they were outperformed by those who showed confidence in, and love for mathematics. Learners who did not have interest in, and are less committed to mathematics, usually underperformed and obtained low levels in the subject (Harris & Bourne, 2017; Mupa, 2015). It is therefore crucial that mathematics teachers must support and be patient in building learners' self-concepts to enable them to do well in mathematics and that will ultimately enhance good performance (Bosman & Schulze, 2018). It is indisputable that the attitude of learners towards mathematics plays an important role in the success of the teaching and learning processes (Harris & Bourne, 2017).

This study revealed that when appropriate and different teaching strategies are used in the teaching of mathematics, learners tend to show more interest and enjoy learning the subject, as reflected by HOD B when he was requested to comment on the teachers' and learners' attitude at his school towards mathematics. The performance of the learners showed improvement in school B and that could be linked to their positive attitude towards the subject, which is the result of varied strategies in the teaching and learning processes. This is evident in the fact that teachers and learners in school B went an extra mile and conducted weekend classes as an indication that they enjoyed the subject and would like to have more time doing it.

## 5.4 IMPLICATIONS OF THE RESULTS

Based on the findings of this study and drawing lessons from top performing countries in mathematics, it emerged that teaching strategies have an impact on the learners' academic performance in mathematics. Furthermore, it emerged that quality and effective teaching and learning of mathematics are grounded on the constructivist theory. It also emerged that the choice and use of appropriate teaching strategies coupled with the availability of relevant resources work towards positive

learning gains. Similarly, learners' preferences of teaching and learning strategies must be considered towards the development and sustenance of a positive attitude towards mathematics. The findings of this study presented the following implications for teachers, SMTs, principals, officials of the department at the circuit and district levels as well as policy makers:

### 5.4.1 Implications for teachers

Teachers are soldiers posted in the front line of the battle to fight for productive and responsive education. They have a salient role to play in ensuring that learners enjoy schooling and learning. For teacher to achieve that will not come cheap; but the love for their job, selfless dedication and hard work must come in. All other stakeholders in education await the outcomes of the teachers' and learners' interaction in the classroom. Teachers must participate in the plenary, presentation, assessment and analysis of classroom instruction until the end point which is the final outcome or results of the learners. Teachers are where things are happening; they make things happen through teaching and learning. The findings of this study have the following implications for teachers:

- Lesson planning should start with the choice of a teaching strategy which would be appropriate for the topic and the content to be presented.
- There is no one-size-fits-all teaching strategy, hence variation of teaching strategies as well as combination of traditional and participatory teaching strategies is highly recommended as it was proved to be linked to learners' enjoyment of mathematics and improved performance in the subject.
- Teachers need to work hard to ensure that classrooms are transformed into learning centres; using every available space in the classroom for learning through charts, drawings, pictures and other resources.
- Teachers have a role to play in ensuring that the learning of mathematics is designed in a manner that incorporates fantasy to eradicate the negative attitude and dislike learners hold against mathematics.

It is high time that teachers embrace technology in the teaching of mathematics during this era of the fourth industrial revolution. The teachers do not have any choice because their learners are advanced and have shown extreme interest in technology such that the only way to capture their attention would be to go the ICT

route for teaching and learning. The few available technology gadgets should be used for mathematics teaching and learning.

Teachers need to learn to complement each other as there is no master of all. Good teachers also have challenges in the presentation of other topics. It is therefore important to engage in collaborative teaching to close gaps in the teachers' mastery of content knowledge. Teachers must consider bringing in other mathematics teachers and engage in team teaching as it was linked to better performance in mathematics.

### 5.4.2 Implications for SMTs and SGBs

Principals and SMTs must shift their focus from the end product (analysis of results) to monitoring the processes (teaching and learning) as a means to support teachers for improved performance in mathematics. Effective curriculum management remains indispensible for quality teaching and assessment of mathematics.

Principals and deputy principals must support and monitor the HODs to ensure that the teaching and learning process is scrutinized; starting from lesson planning, checking the choice of teaching strategies, advising and supporting the teachers to organize the LTSM needed for every set of lessons.

School based development programs must be designed; including training and workshops to build the capacity of teachers on the strategies for lesson presentation to build their confidence in the teaching of mathematics. The implementation of ICT in the teaching of mathematics requires support from the SMT. SMT members must design their monitoring instruments to include follow-up on the implementation of ICT.

The principals and SGBs must consider resourcing mathematics departments and using their school budget to procure resources including ICT gadgets for quality mathematics teaching and to enable teachers to vary their teaching strategies.

### 5.4.3 Implications for education authorities

This study established that teaching strategies have an effect on the teaching and learning of mathematics. It would therefore be beneficial for teachers if programs are designed to have frequent workshops and training sessions on different teaching strategies for the teaching of mathematics as well as modelling these strategies to

build the capacity of teachers. The ATP was found elaborative on what and when to teach; however, it was silent on the how part of teaching. To alleviate dependency on one strategy, it would assist teachers if the ATP could suggest teaching strategies to be used for a particular topic. It would also assist if teachers would be required to specify their teaching strategies and their choice of resources in the planning of every lesson and making this a national standard. The provision of resources, particularly for mathematics teaching would bring desirable changes in the teaching of this subject and ultimately improvement in learner attainment.

## 5.5 LIMITATIONS OF THE STUDY

The purpose of this study was to explore teaching strategies that would contribute to the improvement of the performance of Grade 9 learners in mathematics in Mkhuhlu Circuit. I am working in the circuit that was sampled for this study and the participants of this study are all my subordinates who, despite my declaration of the purpose of the study, might have wanted to impress me and told me what I needed to hear and not the true reflection of the actual practices in their schools. This study adopted a qualitative approach; thus, making it explorative and descriptive in nature. Consequently, the study had methodological limitations. Given that qualitative studies are subjective in nature, the findings of this study may not reflect the reality as is because the researcher relied on the participants' opinions and honesty as well as their willingness to disclose the truth. Furthermore, as subjective analysis is the lifeblood and nature of qualitative studies, potential researcher biasness in the interpretation of data could have affected the quality and credibility of the research findings. However, as a mitigation factor to this limitation, multiple data collection methods were used to ensure credibility of the findings. The researcher conducted observations and studied documents and artefacts to augment the facts raised by the respondents and to discover what could not be revealed through interviews.

Furthermore, the study had sample characteristic limitations. The sample population was drawn from only two secondary schools and the participants in each school were only members of the school management team which included only the principal, an ES, and the subject teacher. The size of the respondent sample was relatively small to draw a plausible generalization for the entire circuit made of eleven secondary schools based on the behaviour and opinions of the respondents. To address this limitation, a future study is recommended where a larger sample

population would be involved; including SGBs and other stakeholders in the education fraternity.

## 5.6 CONCLUSION

This study unearthed the teaching strategies used by teachers in the teaching of Grade 9 mathematics in Mkhuhlu Circuit and the impact of the choice of these strategies on the success of the teaching and learning of mathematics. The study further suggested different strategies which could be used for effective teaching and learning of mathematics. This was achieved by drawing lessons for productive mathematics instruction from top performing countries like Singapore and South Korea. These countries' choice and preferences of teaching strategies and availability of resources including the use of technology appeared to have positive contribution towards good performance in mathematics. I hold an inert conviction that this study, the findings and implications thereof to the different role players in education, will add value to the body of knowledge; particularly in the endeavour to bring positive changes in the performance of learners in mathematics, not only in Grade 9 but across all grades.

## REFERENCES


Abdulkarim, A., & Baba, M. M. (2019). TEACHERS PERCEPTION OF THE CAUSES OF POOR PERFORMANCE IN MATHEMATICS AMONG PUBLIC SECONDARY SCHOOLS STUDENTS IN GOMBE STATE, NIGERIA: IMPLICATIONS FOR COUNSELING FOR NATIONAL DEVELOPMENT . *Journal of Information Technology Educators and Research Vol 1(2)*.

Abramovich, S. (2017). DIVERSIFYING MATHEMATICS TEACHING: Advanced Educational Content and Methods for Prospective Elementary Teachers.

Adu, K. O., Adu, E. O., & Chikungwa-Everson, T. (2017). Learners' Perception on the Importance of Utilizing Teaching Resources in Grade 9 Mathematics Classroom. *International Journal of Education Vol 16*.

Adunola, O. (2011). The impact of teachers'teaching methods on the academic performance of primary school pupils in Ijebu-Ode local cut area of Ogun State.

Alabekee, E. C., Samuel, A., & Osaat, S. D. (2015). Effect of Cooperative learning strategy on students learning experience and achievement in mathematics. *International Journal of Education Learning and Development*, 67-75.

Alias, B. S., Zainudin, Z. N., & Nasri, N. M. (2018). Curriculum management competency of Malaysia's Principals. *Journal of Academic Research in Business and Social Sciences, Vol 8(10)*, 1101- 1107.

Amineh, R. J., & Asl, H. D. (2015). Review of Constructivism and Social Constructivism. *Journal of Social Sciences, Literature and Languages, Vol 1(1)*, 9-16.

Awofala, A. O., & Lawani, A. O. (2020). Increasing Mathematics Achievement of Senior Secondary School Students through Differentiated Instruction. *Journal of Educational Sciences Vol. 4(1 )*, 1-19.

Ayal, C. S., Kusuma, Y. S., Sabandar, J., & Dahlan, J. A. (2016). The Enhancement of Mathematical Reasoning Ability of Junior High School Students by Applying Mind Mapping Strategy. *Journal of Education and Practice, Vol. 7(25)*, 50-58.

Bada, D., & Olusegun, S. (2015). Constructivism Learning Theory: A paradigm for Teaching and Learning. *IOSR Journal of Research and Method in Education, Volume 5, Issue 6*, 66-70.

Bature, I., & Jibrin, A. (2015). The perception of preservice mathematics teachers on the role of scaffolding in achieving quality mathematics classroom instruction. *International Lournal of Education in Mathematics Science and Technology Vol.3 (4)*, 275-287.

Borg, P., Hewitt, D., & Jones, I. (2016). Authors' Response: The M-N-L framework: Bringing radical constructivism theories to daily teaching practices. *Constructivist Foundation, Volume 12 (1)*, 83-90.

Bosman, A., & Schulze, S. (2018). Learning style preferences and Mathematics achievement of secondary school learners. *South African Journal of Education*, 1440.

Boyd, P., & Ash, A. (2018). Mastery mathematics: Changing teacher belief around in-class grouping and mindset. *Teaching and Teacher Education Journal 75* , 214-223.

Boyd, P., & Ash, A. (2018). Teachers framing explotary learning within a text book based Singapore mathematics mastery approach. *Teacher Education Advancement Network Journal 10 (1)*, 62-73.

Brumbugh, D. K., & Rock, D. (2011). *Teaching Secondary Mathematics.* 2 Park Square - Milton Park , Abingdon: Routledge -Taylor & Francis Group.

Chikodzi, I., & Nyota, S. (2010). The Interplay of Culture and Mathematics: The Rural Shona Classroom . *The Journal of Pan African Studies, Vol.3 (10)* .

Chiobanu, N. R. (2018). Active and Participatory Teaching Methods. *Europian Journal of Education. Vol 1, Issue 2*.

Claven, J., Crespo, F., & Me'ndez, I. (2016). Are teacher characteristics and teaching practices associated with student performance? *Policy Brief No. 11.* Amsterdam, The Netherlands.

Clerkin, A., Perkins, R., & Cunningham, R. (2016). TIMSS 2015 in Ireland: Mathematics and Science in Primary and Post-Primary schools.

Cohenmiller, A. S., Merril, M., & Shamatov, D. (2018). Effective Teaching Strategies: a Brief Overview. *Pedagogical Dialogue, Vol 1(23)*.

Cohenmiller, A. S., Merrill, M., & Shamatov, D. (2018). Effective Teaching Strategies:A brief overview.

Commission, N. P. (2011). *National Development Plan:Vision 2030.* Pretoria: Presidency.

Creswell, J. W. (2014). *Research design: Qualitative, Quantitative and Mixed Methods Approaches.*

Creswell, J. W., & Creswell, J. D. (2018). *Qualitative, Quantitative, and Mixed methods Approaches: Fifth Edition.* Thousana Oaks, Califonia: Sage Publications.

Davies, P., & Hersh, R. (2012). *The Mathematical Experience.* Boston: Mifflin Company.

Dignath, C., & Buttner, G. (2018). Teachers' direct and indirect promotion of self-regulated learning in primary and secondary school mathematics classes- insight from video-based classroom observations and teacher interviews. *ResearchGate*.

Dimitrios, T., & Antigoni, F. (2018). Limitations and Delimitations in the research process. *Perioperative Nursing, Volume 7, Issue 3*.

Djenic, S., & Mitic, J. (2017). Teaching Strategies and methods in modern environments for learning of programming. *14th International Conference on Cognition and Exploratory learning in Digital age (CELDA).* Vojvode Stepe 283, 11000 Belgrade, Serbia: The School of Electrical and Computer Engineering of Applied Studies .

DoBE. (2012). Curriculum and Assessment Policy Statement . Mathematics Further Education and Training Phase Grade 10-12. *National Curriculum Statement (NCS)*. Pretoria: Department of Basic Education.

DoBE. (2015). Report on the Annual National Assessment of 2014. Department of Basic Education.

Efron, S. E., & Ravid, R. (2013). *Action Research in Education: A practical guide.* New York, London: The Guilford Press.

Eltanahy, M., & David, s. A. (2018). A study investigating the factors influencing predominent teaching strategies used in AmericanCurriculum schoolsin the United Arab Emirates.

Enriquez, J. A., Oliveira, A. M., & Valencia, H. G. (2018). What Mathematic Teachers Say about the Teaching Strategies in the Implementation of Tasks. *English Language Teaching, Vol. 11(1)*, 65.

Fernando, S. Y., & Marikar, F. M. (2017). Constructivist Teaching / Learning Theory and Participatory Teaching Methods. *Journal of Curriculum and Teaching. Vol 6 (1)*, 110.

Freedman, L. (2013). *Strategy a History.* Oxford University Press.

Freedman, L. (2017). *The transformation of strategic affairs.*

Galina, D. (2019). Modern ICT ways to prepare a child for life and career in the digital world. *Global Dialoque on ICT and Education Innovation-Towards Sustainable Development Goal for Education (SDG4).* Moscow, Russia: UNESCO.

Ganyaupfu, E. M. (2013). Teaching Methods and Students' Academic Performance. *International Journal of Humanities and Social Science invention. Vol 2, Issue 9*.

Gengle, H. I., Abel, M. A., & Mohammed, B. K. (2017). Effective Teaching and Learning Strategies in Science and Mathematics to Improve Students' Academic Performance in Nigeria .

Gentles, t. J., Charles, C., Ploeg, J., & Mckibbon, K. A. (2015). Sampling in Qualitative Research: Insight from the Methods Literature. *The Qualitative Report*, 1772-1789.

George, A., & Adu, E. (2018). Motivation and Attitude of Grade Nine Learners Towards Mathematics in King Williams Town Education Distrct, South Africa. *Ghana Journal of Development studies, Vol.15(1)*.

Given, L. M. (2008). *The SAGE Encyclopedia of Qualitative Research Methods. Volume 1&2.*

Glaserfeld, E. v. (1989). Constructivism in Education. In T. Husen, & T. P. (eds), *The International Encyclopedia of Education, supplement.* New York: Oxford, Pergamon Press.

Graue, C. (2015). Qualitative Data Analysis. *International Journal of Sales, Retail and Marketing, Vol 4 (9)*, 5-14.

Graven, M., Venkat, H., Essien, A. A., & Vale, P. (2019). Proceedings of the 43rd Conference of the International Group for the Psychology of Mathematics Education (Vol 1). Pretoria, South Africa: PME.

Gray, A. (1997). Constructivist Teaching and Learning. *SSTA Research Centre Report*.

Grussendorff, S., & Booyse, C. (2014). *What's in the CAPS package? A comparative study of the National Curriculum Statement (NCS) and the Curriculum an Assessment Policy Statement (CAPS):FET phase. Overview.* Pretoria: Umalusi.

Habibi, Kuswanto, H., & Yanti, F. A. (2017). Exploration of Teaching Skills of Pre-service High School Teachers' Through Self -regulated Learning Based on Learning Style.

Hagoramagara, F. (2015). The impact of grade 10 learners' behaviour on their academic performance in mathematics. *Doctoral Dissertation*.

Harris, J., & Bourne, P. A. (2017). Perception of teachers and pupils on factors influencing academic performance in Mathematics among a group of fifth and sixth graders in Jamaica. *Young Scientist- Tomorrow Science Begins Today. Vol 1(1)*.

Horwath, R. (2006). The origin of Strategy. *Strategic Thinking Institute*.

Hsien, F.-J., Wang, T.-Y., & Chen, Q. (2020). Ideal Mathematics Teaching Behaviors: A Comparison of Perspectves between Senior High School Students and their Teachers in Taiwan and Mainland China. *EURASIA Journal of Mathematics, Science and Technology Education. Vol16(1)*.

Johnson, R. B., & Christensen, L. (2014). *Educational Research: Quantitative, Qualitative and Mixed Approaches: 5th Edition.* United States of America: Sage Publication.

Johnston-Wilder, S., Johnston-Wilder, P., Pimm, D., & Lee, C. (2011). Learning to Teach Mathematics in the Secondary School :A companion to school experience, 3rd edition.

Jojo, Z. (2019). Mathematics Education System in South Africa.

Karakolidis, A., Pitsia, V., & Emvalotis, A. (2016). Mathematics low achievement in Greece: A multilevel analysis of the Programme for International Student Assessment (PISA) 2012 data. *Themes in Science and Technology Education, Vol. 9(1)*, 3-24.

Kaur, B. (2014). Evolution of Singapore's School mathematics Curriculum.

Kim, Y. (2020). Korean Teachers' Mathematical Knowledge fro Teaching in Algebraic Reasoning. *Journal of Education Research in Mathematics*, 185-198.

Ko, J., & Sammons, P. (2013). Effective Teaching: A Review of Research and Evidence. *CfBT Education Trust*.

Kubiatko, M. (2017). Are ICT being used correctly? Small reflection about correct using of ICT in education. *Problems of Education in the 21st Century. Vol 75(1)*.

Kucharčíková, A., & Tokarčíková, E. (2016). Use of participatory methods in teaching at the university. *The online Journal of Science and Technology, Vol 6(1)*.

Kumar, S. (2018). Use of Teaching Methods at Higher Education Institutions. *Scholarly Research Journal for Interdisciplinary studies, Vol 5(43)*.

Leavy, P. (2017). *Research Design: Quantitative, Qualitative, Mixed Methods, Art-Based and Community-Based.*

Lee, H.-F., & Seah, W. T. (2015). "Math is not for us, not an indigenous thing, you know": Empowering Taiwanese indigenous learners of mathematics through the values approach. *In Eight International Mathematics Education and Society Conference.* Portland, OR: ResearchGate.

Lorachelle, M., Bednarz, N., & Garrison, J. (1998). *Constructivism and Education.* New York: Cambridge University Press.

Lwin, Y. Y., & Oo, W. W. (2020). The effect of participatory teaching methods on students achievements in mathematics at the middle school level. *J. Myammar Acad. Arts Sci. Vol XVIII No. 9C*.

Makamure, C. (2018). EVOKING MOTIVATION FOR ACHIEVEMENT IN 'O' LEVEL MATHEMATICS IN ZIMBABWE. *International Journal of education (IJE), Vol. 6(4)*.

Marshall, C., & Rossman, G. (2011). *Designing Qualitative Research (5th ed).* Thousand Oaks, CA Sage.

Mattar, J. (2018). Constructivism and connectivism in education technology: Active, situated, authentic, experiential, and anchored learning. *RIED. Revista Iberoamericana de Educacion a Distancia*, 201-217.

McAleavy, T., Ha, T. T., & Fitzpatrick, R. (2018). *Promising Practice Government Schools in Vietnam.*

McLeod, S. (2019). *Constructivism as a theory for teaching and learning.*

McMillan, J. H. (2016). *Fundamentals of Education Research. Seventh Edition.*

McMillan, J., & Schumacher, S. (2010). *Research in Education: Evidence -Based Inquiry. .*

McMillan, J., & Schumacher, S. (2010). *Research in Education: Evidence-Based Inquiry, My EducationLab Series.* Boston: Pearson.

Mokgwathi, M. S., Graham, m. A., & Fraser, W. (2019). The relationship between Grade 9 teacher's and learner's perceptions and attitudes with their mathematics achievement. *International Juornal of Instruction. Vol. 12(1)*.

Moshoana, M. D., & Thaba-Nkadimene, K. L. (2016). Promoting the culture of teaching and learning through effective curriculum management. *South Africa International Conference on education "Towards Excellence in Educational Practices"* (pp. 188-198). Pretoria, South Africa: African Academic Research Forum .

Muema, J., Mulwa, D., & Mailu, S. (2018). Relationship Between Teaching Method And Students' Performance In Mathematics In Public Secondary Schools In Dadaab Sub County, Garissa County; Kenya . *Relationship Between Teaching Method And Students' Performance In Mathematics In Public Secondary Schools In Dadaab Sub County, Garissa County; Kenya* .

Munyaradzi, G. (2013). Teaching Methods and Student's academic performance.

Mupa, P. (2015). Foundations for success in the teaching of O-level mathematics in rural day secondary schools in Masvingo district . *Journal of Education and Practice Vol 6 (19)*.

Mupa, P., & Chinooneka, T. I. (2015). Factors contributing to ineffective teaching and learning in primary schools: Why are schools in decadence? . *Journal of Education and Practice Vol 6 (19)*.

Mutodi, P., & Ngirande, H. (2014). The Influence of Students Perceptions on Mathematics Performance. A case of a Selected High School in South Africa. *Mediterranean Journal of social Sciences Vol 5 (3)*, 431.

Namitha, C. (2018). Modern methods of teaching. *Journal of Applied and Advanced Research. Vol 3 S1.167*.

NEEDU. (2017). Schools that Work II: Lessons from the ground.

Neuman, L. (2014). *Social Research Methods: Qualitative and Quantitative Approaches. Seventh Edition.*

Ngusa, J., Begi, N., & Ndani, M. (2018). Relationship between school learning environment and pupil's performance in mathematics in Nairobi country .

Ocasio, W., & Joseph, J. (2018). Strategy Science- The Attention -Based View of Great Strategies.

Ogbeba. (2010). The Challenge of Effective Science Teaching in Nigerian Secondary Schools. *Academic Journal of Interdisciplinary studies MCSER, Vol 2(7)*, 181-188.

Okwuduba, E. N., & Okigbo, E. C. (2018). Effect of teaching methods on students' academic performance in chemistry in Nigeria: Meta-analytic review. *Bugarian Journal of Science and Education Policy (BJSEP) Vol. 12(2)*.

Olorunfemi, S., Olawumi, K., & Adu, E. o. (2018). ASSESSING GRADE 9 LEARNERS' ATTITUDE TOWARDS THEIR ACADEMIC PERFORMANCE IN MATHEMATICS IN PINETOWN EDUCATION DISTRICT, KWAZULU-NATAL. *Journal of Research and Opinion. Vol 5 (9)*, 2253-2265.

Omoifo, C. (2012). Dance of the limit-reversing the trends in science education in Nigeria. . *Inaugural Lecture Series 124*, 13-36.

Omorogbe, E., & Ewansiha, J. (2013). The Challenge of Effective Science Teaching in Nigerian Secondary Schools. *Academic Journal of Interdisciplinary studies MCSER Vol 2(7)*, 181-188.

Ostrowick, J. (2019). Challenges in empowering teachers to use ICT in teaching and learning in South Africa. *Global Dialoque on ICT and Education Innovation- Towards Sustainable Development Goal for Education (SDG4).* Moscow, Russia: UNESCO.

Owens, M. T. (2007). Strategy and the Strategic Way of Thinking. *Naval War College Review: Vol. 60 : No. 4, Article 10*.

Patton, M. Q. (2018). *Qualitative Research & Evaluation Methods : Fourth Edition.* United States of America: Sage Publications.

Pournara, C., Hodgen, J., Adler, J., & Pillay, V. (2015). Can improving teachers' knowledge of mathematics lead to gains in learners' attainment in mathematics? *South African Journal of Education, Vol. 35(3)*, 1083.

Pournara, C., Mpofu, S., & Sanders, Y. (2015). The Grade 9 Maths ANA- What can we see after three years.

Powell, K. C., & Kalina, C. (2009). Cognitive and Social Constructivism:Developing tools for an effective classroom. *Education, 130 (2)*, 241-250.

Raba, A. A. (2017). The impact of effective teaching strategies on producing fast and good outcomes.

Rahayu, P., & Siregar, S. (2018). Teaching strategies in students' micro teaching.

Ramelan, M., & Wijaya, A. (2019). A comparitive Analysis of Indonesian and Singaporean Mathematics Textbiiks from a Perspective of Mathematical Creativity: A case statistics and Probability.

Reddy, V., Jean, A., Isdale, K., & Fongwa, S. (2019). Mathematics Achievement and the Inequality Gap: TIMSS 1995 to 2015.

Sa'ad, T. U., Adamu, A., & Sadiq, A. M. (2014). The Causes of Poor Performance in Mathematics among Public Senior Secondary School Students in Azare Metropolis of Bauchi State, Nigeria. *IOSR Journal of Research & Method in Education, Vol. 4 (6)*, 32-40.

Safdar, A., Yousof, M. I., Parveen, Q., & Behlol, M. G. (2011). Effectiveness of Information and communication Technology in teaching mathematics at secondary level. *International Journal of Academic Resaerch. Vol 3(5)*.

Salami, I., & Okeke, C. (2017). Transformation and decolonisation of mathematics education for sustainable development: A case study of its learning trend in Nigeria. *Perspectives in Education. Vol. 35(2)*, 45-59.

Sandefur, J. (2016). Internationally Comparable Mathematics Scores for Fourteen African Countries.

Simba, N. O., Agak, J. O., & Kabuka, E. K. (2016). Impact of Discipline on academic Performance of Pupils in Public Primary Schools in Muhoroni Sub-Country, Kenya. *Journal of Education Practice, Vol. 7(6)*, 164-173.

Sinyosi, L. B. (2015). *Factors affecting grade 12 learners' performance in mathematics at Nzelele East District: Vhembe District in Limpopo.*

Siyepu, S. (2013). The zone of proximal development in the learning of mathematics. *South African Journal of Education, Vol 33(2)*, 714.

Spaull, N. (2012). Poverty & Privilege: Primary School Inequality in South Africa. *A working paper of the department of economics and the bureau for economic research at the University of Stellenbosch*.

Spaull, N. (2015). Schooling in South Africa: How low-quality education becomes a poverty trap.

Spaull, N., & Kotze, J. (2014). Starting Behind and Staying behind in S.A: The case if insurmountable learning deficits in mathematics.

Staden, S. v., & Motsamai, P. (2017). Differences in the quality of school-based assessment: Evidence in Grade 9 mathematics achievement.

Stols, G., Ferreira, R., Pelser, A., Olivier, W., & A. Van der Merve, C. D. (2015). Perceptions and needs of South African Mathematics teachers concerning their use of technology for instruction. *South Africa Journal of Education, Vol. 35(4)*.

Thomson, S., Wernert, N., O'Grady, E., & Rodrigues, S. (2016). TIMSS 2015: A first look at Australia's results.

Toh, T. L. (2017). On Singapore prospective ssecondary school teacher's mathematical content knowledge. *International Journal for mathematics Teaching and Learning Vol18*, 1-25.

Tracy, S. J. (2013). *Qualitative Researcg Methods: Collecting Evidence, Crafting Analysis, Communicating Impact, First Edition.* West Sussex, UK: Blackwell Publishing Ltd.

Trinh, T. P., Pham, T. V., Cao, H. T., Nguyen, T.-T., & Tran, T. T. (2019). THE PROFILE OF PROFESSIONAL STANDARDS FOR SECONDARY SCHOOL PRINCIPALS IN VIETNAM International Journal of Education and Practice 2019 Vol. 7, No. 4, pp. 310-323. *International Journal of Education and Practice Vol. 7(4)*, 310-323.

Ünal, M. (2017). Preferences of Teaching Methods and Techniques in Mathematics with Reasons. *Universal Journal of Educational Research, Vol 5(2):* , 194-202.

Van der Berg, S. (2015). What the Annual National Assessments can tell us about learning deficits over the education system and the school career. *South African Journal of Childhood Education*.

van der Grift, W. J., Chun, S., Maulana, R., Lee, O., & Helms-Lorenz, M. (2017). Measuring teaching quality and student engagement in South Korea and Netherlands, School Effectiveness and School Improvement. *An International Journal of Research, Policy and Practice, 82(3)*, 337-349.

van der Wal, L. G., & Jojo, Z. M. (2014). Exploring Teaching Strategies to Attain High Performance in Grade Eight mathematics: A Case Study of Chungcheongbuk Province, South Korea. *Mediterranean Journal of Social Sciences Vol 5(23)*.

Wesonga, F., & Aurah, C. (2019). Instructional Strategies and Learning Styles as Predictors of High School students' Academic Performance in Physics Prscticals in Kenya. *Proceedings of the 2nd International Conference on Future Education, Vol 2 (1)*.

Wragg, E. (2012). *An introduction to classroom observation (2nd ed).* London: Routledge.

Yawman, M. W., & Kubi, J. A. (2018). Innovative Teaching Strategies and Students' Achievement. *Available at SSRN 3161988*.

Zuze, L., Reddy, V., Visser, M., Winnaar, L., & Govender, A. (2017). *TIMSS 2015 Grade 9 National Report:Understanding mathematics and science achievement among Grade 9 learners in South Africa.* Cape Town, South Africa: HSRC.

## APPENDIX A: CERTIFICATE OF LANGUAGE EDITING

This is to certify that I have edited the dissertation titled **"Exploring teaching strategies to improve the performance of Grade 9 learners in Mathematics in Mkhuhlu circuit, Bohlabela District" by MTHEMTHWA V.S.** in terms of language usage, style, expression and consistency.

I focused on grammar, tenses, consistency of terminology, sentence construction, and logical flow. I inserted comments and suggestions for the attention of the candidate, where meaning needed to be clarified, or where points of confusion could arise for the reader.

I did not edit the list of references or the appendices, which was outside the scope of my brief.

I wish the candidate success with her final submission of this dissertation.

Dr Mafuwane BM (PhD)

Associate member of the Professional Editors' Guild

Membership No: MAF002

**APPENDIX B: Interview Questions For Teachers: Semi – Structured Interview**

**INTERVIEW SCHEDULE**

- Appreciating the participant for availing themselves to participate in the interview
- Introduction of the research topic and its significance to the participant
- Confirmation to the participant of anonymity and confidentiality on whatever they say is emphasised.
- Participant's consent is sought for the researcher to use audio recording devices and a rationale thereof is clarified.

**Explanation of the abbreviations used.**

ATP = Annual Teaching Plan
SPIP = Subject Performance Improvement Plan
LTSM = Learning and Teaching Support Materials
RES = Response
QS = Question
MST = Mathematics, Science and Technology
ICT = Information and Communication Technology

**Basic and background information**

I. What is your age?

| | |
|---|---|
| 21 - 30 years | |
| 31 – 40 years | |
| 41yr – and above | |

II. What is your gender

| | |
|---|---|
| | Male |
| | Female |

III. What is your highest qualification in Mathematics?

| | |
|---|---|
| 3.1 Graduate (B.A, B. Ed, B. Tech) | |
| 3.2 Post Graduate (B. Ed Hons, M. Ed, D, Tech) | |
| 3.3 Professional Diploma (JPTD, SPTD, STD) | |
| 3.4 Other (Specify) | |

IV. Years of Mathematics teaching experience

| | |
|---|---|
| 0 -5 years | |

V. Status of the school

| | |
|---|---|
| 6 – 10 years | |
| 11 – and above | |

| | |
|---|---|
| Public School | |
| Independent School | |
| MST Grant School | |

1. QS

- Which Learning and Teaching support Materials (LTSM) do you use in teaching mathematics?

RES_____

_____

_____

2. QS

- Does the Annual Teaching Plan (ATP) specify the teaching strategies/method to be used in presenting a particular lesson?

| YES | NO |
|---|---|

- If NO, which are the teaching strategies/methods that you usually employ in presenting your lessons?

- And which strategy/method works best for you?

RES_____

_____

_____

3. QS

- Does the ATP specify the LTSM to be utilised for a specific topic or lesson?

| YES | NO |
|---|---|

- If NO, which resources do you usually utilize when teaching mathematics?

RES_____

_____

_____

4. QS

What do you understand about 'learner-centred' instruction/ teaching?

RES_____

_____

_____

5. QS

- According to your understanding, what does cooperative learning mean? Do you engage your learners in cooperative learning? If 'yes', please share how do you do it.

RES_____

_____

_____

6. QS

- Which ICT resources do you have access to at your school? Do you utilize ICT resources in mathematics teaching?

RES_____

_____

_____

7. QS

- What kind of support do you receive from your supervisor?

RES_____

_____

_____

8. QS

1. What kind of support do you receive from the Subject Advisor?

RES_____

_____

_____

9. QS

2. Do you manage to cover content as prescribed by the ATP per week or month? (YES/NO

RES_____

_____

_____

**APPENDIX C: Interview Questions For Education Specialists: Semi – Structured Interview**

**INTERVIEW SCHEDULE**

- Appreciating the participant for availing themselves to participate in the interview
- Introduction of the research topic and its significance to the participant
- Confirmation to the participant of anonymity and confidentiality on whatever they say is emphasised.
- Participant's consent is sought for the researcher to use audio recording devices and a rationale thereof is clarified.

**Explanation of the abbreviations used.**

ATP = Annual Teaching Plan
SPIP = Subject Performance Improvement Plan
LTSM = Learning and Teaching Support Materials
RES = Response
QS = Question
MST = Mathematics, Science and Technology
ICT = Information and Communication Technology

**Basic and background information**

I. What is your age?

| | |
|---|---|
| 21 - 30 years | |
| 31 – 40 years | |
| 41yr – and above | |

II. What is your gender

| | |
|---|---|
| Male | |
| Female | |

III. What is your highest qualification in Mathematics?

| | |
|---|---|
| 3.1 Graduate (B.A, B. Ed, B. Tech) | |
| 3.2 Post Graduate (B. Ed Hons, M. Ed, D, Tech) | |
| 3.3 Professional Diploma (JPTD, SPTD, STD) | |
| 3.4 Other (Specify) | |

IV. Years of Mathematics teaching experience

| | |
|---|---|
| 0 -5 years | |

V. Status of the school

| | |
|---|---|
| 6 – 10 years | |
| 11 – and above | |

| | |
|---|---|
| Public School | |
| Independent School | |
| MST Grant School | |

VI. Years of management experience

| | |
|---|---|
| 0 -5 years | |
| 6 – 10 years | |
| 11 – and above | |

**APPENDIX D: Interview Questions For Principals: Semi – Structured Interview**

**INTERVIEW SCHEDULE**

- Appreciating the participant for availing themselves to participate in the interview
- Introduction of the research topic and its significance to the participant
- Confirmation to the participant of anonymity and confidentiality on whatever they say is emphasised.
- Participant's consent is sought for the researcher to use audio recording devices and a rationale thereof is clarified.

**Explanation of the abbreviations used.**

ATP = Annual Teaching Plan

SPIP = Subject Performance Improvement Plan

LTSM = Learning and Teaching Support Materials

RES = Response

QS = Question

MST = Mathematics, Science and Technology

ICT = Information and Communication Technology

**Basic and background information**

I. What is your age?

| | |
|---|---|
| 21 - 30 years | 1 |
| 31 – 40 years | 2 |
| 41yr – and above | 3 |

II. What is your gender

| | |
|---|---|
| Male | 1 |
| Female | 2 |

III. What is your highest qualification in Mathematics?

| | |
|---|---|
| 3.1 Graduate (B.A, B. Ed, B. Tech) | 1 |
| 3.2 Post Graduate (B. Ed Hons, M. Ed, D, Tech) | 2 |
| 3.3 Professional Diploma (JPTD, SPTD, STD) | 3 |
| 3.4 Other (Specify) | 4 |

IV. Years of management experience

| | |
|---|---|
| 0 -5 years | 1 |
| 6 – 10 years | 2 |
| 11 – and above | 3 |

V. Status of the school

| | |
|---|---|
| Public School | 1 |
| Independent School | 2 |
| MST Grant School | 3 |

VI. Years of principalship experience

| | |
|---|---|
| 0 -5 years | 1 |
| 6 – 10 years | 2 |
| 11 – and above | 3 |

1. QS

3. Are all teachers responsible for Mathematics qualified to teach the subject?

RES_____

_____

_____

2. QS

- Do Mathematics teachers have enough LTSM? | YES | NO |

- Which are the teaching aids /LTSM that teachers utilize for the advancement of quality teaching and learning in mathematics?

RES_____

_____

_____

3. QS

- How is Grade 9 Mathematics performance in this school? And what are the factors affecting mathematics performance within your school in Grade 9?

RES_____

_____

_____

4. QS

- Which support is given to mathematics department towards improved performance in the subject?
- Which ICT resources are available at your school for the advancement of mathematics teaching and learning?

RES_____

_____

_____

5. QS

- Do you have teachers' development programs for Mathematics teachers?
- Do these programs address the issue of teaching strategies?

RES_____

_____

_____

6. QS

- How often do the HOD's conduct class visits and hold departmental meetings?
- How do you follow-up on the findings of class visits and the discussions in departmental meetings?

RES_____

_____

_____

7. QS

How do Subject advisors support mathematics teachers?

RES_____

_____

_____

8. QS

4. How is your teachers and learners' attitude toward mathematics?

RES_____

_____

_____

**APPENDIX E: Interview Questions For Subject Advisor: Semi – Structured Interview**

**INTERVIEW SCHEDULE**

- Appreciating the participant for availing themselves to participate in the interview
- Introduction of the research topic and its significance to the participant
- Confirmation to the participant of anonymity and confidentiality on whatever they say is emphasised.
- Participant's consent is sought for the researcher to use audio recording devices and a rationale thereof is clarified.

**Explanation of the abbreviations used.**

ATP = Annual Teaching Plan
SPIP = Subject Performance Improvement Plan
LTSM = Learning and Teaching Support Materials
RES = Response
QS = Question
MST = Mathematics, Science and Technology

**Basic and background information**

I. What is your age?

| | |
|---|---|
| 21 - 30 years | 1 |
| 31 – 40 years | 2 |
| 41yr – and above | 3 |

II. What is your gender

| | |
|---|---|
| Male | 1 |
| Female | 2 |

III. What is your highest qualification in Mathematics?

| | |
|---|---|
| 3.1 Graduate (B.A, B. Ed, B. Tech) | 1 |
| 3.2 Post Graduate (B. Ed Hons, M. Ed, D, Tech) | 2 |
| 3.3 Professional Diploma (JPTD, SPTD, STD) | 3 |
| 3.4 Other (Specify) | 4 |

IV. Years of Mathematics teaching experience

| | |
|---|---|
| 0 -5 years | 1 |
| 6 – 10 years | 2 |
| 11 – and above | 3 |

VI. Years of experience as Subject Advisor

| | |
|---|---|
| 0 -5 years | 1 |
| 6 – 10 years | 2 |
| 11 – and above | 3 |

1. QS

What is your role as mathematics Subject Advisor at a school level?

RES_____

_____

_____

2. QS

5. What support programs do you have for Mathematics teachers concerning the teaching of the subject?

RES_____

_____

_____

3. QS

6. Do you have development programs for mathematics teachers? | YES | NO |

If YES, may you give a brief of the program(s)?

RES_____

_____

_____

4. QS

How do you assist mathematics teachers with lessons preparations and the choice of teaching strategies?

RES_____

_____

_____

5. QS

May you share the types of teaching strategies often promoted/utilized in the teaching of mathematics?

RES_____

_____

_____

6. QS

According to your experience and observation, which are the teacher-based, learner-based and schoo-based factors affecting performance in mathematics?

RES_____

_____

_____

7.QS

Which resources do teachers and learners have access to for the advancement of quality teaching and learning in mathematics?

RES_____

_____

_____

_____

7. QS

What is your view concerning the use of technology in mathematics teaching?

Which plans do you have (as Department of Education) to embrace technology in the teaching of mathematics?

**APPENDIX F**: Ethical clearance certificate

**University of Limpopo**
**Department of Research Administration and Development**
**Private Bag X1106, Sovenga, 0727, South Africa**
**Tel: (015) 268 3935, Fax: (015) 268 2306, Email: anastasia.ngobe@ul.ac.za**

**TURFLOOP RESEARCH ETHICS COMMITTEE**

**ETHICS CLEARANCE CERTIFICATE**

**MEETING:** **12 August 2020**

**PROJECT NUMBER:** **TREC/152/2020: PG**

**PROJECT:**

| | |
|---|---|
| **Title:** | Exploring Teaching Strategies for Good Mathematics Performance of Grade 9 Learners at Mkhuhlu Circuit, Bohlabela |
| **Researcher:** | VS Mthethwa |
| **Supervisor:** | Prof MJ Themane |
| **Co-Supervisor/s:** | N/A |
| **School:** | Education |
| **Degree:** | Master of Education in Curriculum Studies |

**PROF P MASOKO**
**CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE**
The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: **REC-0310111-031**

**Note:**

i) **This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.**

ii) **Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.**

iii) **PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.**

## APPENDIX G: Response letter from DoE

education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

Ikhamanga Building, Government Boulevard, Riverside Park, Mpumalanga Province
Private Bag X11341, Mbombela, 1200
Tel: 013 766 5552/5115, Toll Free Line: 0800 203 116

Lefiko le Temfundvo, Umnyango we Fundo | Departement van Onderwys | Ndzawulo ya Dyondzo

Ms Venetia Sebenzile Mthethwa
P.O. Box 1527
Bushbuckridge
1280

**RE: EXPLORING TEACHING STRATEGIES FOR GOOD MATHEMATICS PERFORMANCE OF GRADE 9 LEANERS AT MKHUHLU CIRCUIT, MPUMALANGA**

Your application to conduct research study was received and is therefore acknowledged. The tittle of your research project reads: **"Exploring teaching strategies for good mathematics performance of grade 9 leaners at Mkhuhlu circuit, Mpumalanga"**

I trust that the aims and the objectives of the study will benefit the whole department especially the beneficiaries. Your request is approved subject to you observing the provisions of the departmental research policy which is available in the department website. You are requested to adhere to your university's research ethics as spelt out in your research ethics.

In terms of the research policy, data or any research activity can be conducted after school hours as per appointment with affected participants. You are also requested to share your findings with the relevant sections of the department so that we may consider implementing your findings if that will be in the best interest of the department. To this effect, your final approved research report (both soft and hard copy) should be submitted to the department so that your recommendations could be implemented. You may be required to prepare a presentation and present at the departments' annual research dialogue.

For more information kindly liaise with the department's research unit @ 013 766 5476/5148 0r a.baloyi@mpuedu.gov.za
The department wishes you well in this important project and pledges to give you the necessary support you may need.

**MR JR NKOSI**
**[A] HEAD: EDUCATION**

27/08/2020
**DATE**

MPUMALANGA
THE PLACE OF THE RISING SUN

## APPENDIX H: Consent form 1

**SIGNED CONSENT TO PARTICIPATE IN THE STUDY**

Dear colleague

This serves as a declaration that I Fiki Phiksen Bila (Full name and surname), hereby give consent that I will participate in the study titled: **"Exploring teaching strategies for good Mathematics performance of grade 9 learners at Mkhuhlu circuit, Bohlabela).**

I understand that I am participating out of my own free will and that I may decide to withdraw during the process if I feel that I am no longer comfortable or willing to participate in the study. I also understand that my contribution to this study will be treated with strictest confidentiality and that my identity will never be disclosed by any means. I also understand that there will be no payment of any kind as a result of my participation in this study.

Signed:

**Participant** ..... **Date:** 28/09/2020

**Researcher** ..... **Date:** 28/09/2020

19

## APPENDIX I: Letter to schools

ENQ: Ms. Mthethwa D.T
CELL: 0823506399

EMIS : 800035093
Pay Point: 501023

Goromane Trust; Stand No. 200
Mkhuhlu,
P O Box 1856; MKHUHLU;1242
Email: gezingqondo93@gmail.com

To:Mrs Mthethwa V.S
0823532299

Re: REQUEST FOR PARTICIPATION IN A RESEARCH PROJECT

This is in response to your letter dated 25 September 2020 requesting our participation in your research project based on the exploration of teaching strategies for good Mathematics performance of Grade 9 learners at our institution.

We are here to inform you that the school accept and permit you to perform the task as indicated above.

Wishing you all the best in your research

Yours Faithfully

26/09/2020

Principal- Mthethwa D.T

Mpumalanga Dept Of Education
GEZINGQONDO SENIOR SECONDARY SCHOOL
28 -09- 2020
P.O. BOX 1856,MKHUHLU 1346