The factors that influence the increasing performance in Annual National Assessment testing at Grade 6 in Mathematics.

By

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Submitted in accordance with the requirements for the degree of

MASTERS EDUCATION STUDIES

(CURRICULUM STUDIES)

Faculty of Education

UNIVERSITY OF KWAZULU-NATAL

2016

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DECLARATION

I, Raymond Cedrick Penniston, declare that:

The factors that influence the increasing performance in Annual National Assessment testing at Grade 6 in Mathematics is my own work. It has not been submitted for degree purpose at any other University. All sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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Researcher **Date**

_____ _____

Supervisor **Date**

DEDICATION

I dedicate this study to my late father (Mr. Philip Penniston) and mother (Mrs. Elizabeth Penniston) who always taught me to understand the importance of education. Thank you.

ACKNOWLEDGEMENTS

I am deeply grateful for the support and encouragement received from the following people:

- Professor L. Ramrathan, my supervisor, constantly provided full support and motivation to continue with my studies.
- Dr. P Mazibuko-Khuzwayo and Mr M. V. Langa, my friends and colleagues, kept providing me with the power to persevere with my research and reminded me that the end is near.
- Mrs. T Shawe provided a most valuable contribution to my research, as well as support and words of encouragement during my studies.
- Mr. I Koopersamy, Mrs. H J E Coetzee, Mrs. P N Mkhize, Mrs. P S Mkwanazi, Mrs. R Kistan, Mrs. M P Mbatha, Mr VU Kassie and all other staff members provided constant support with their thoughtfulness and appreciation of my studies.
- I am sincerely appreciative to the schools and teachers who participated in my studies.
- Ms. Angela Bryan and Mrs. Melanie De Vos for providing unselfish support and professionalism in editing my research.
- Jade „F‟ Smith, most valuable friend, provided support and encouragement, never gave up on me and used quotes from Mohammed Ali to keep me motivated.
- The most important contributors to my studies were my family. My wife Nosphiwe Penniston, supported me with her time, gave up her beauty sleep, was patient and tolerant and encouraged me to ensure that I succeed. My children Varnel, Chardy and Ty Penniston were always by my side with words of encouragement.

ABSTRACT

This study investigates the performance of schools in the Umlazi district in Annual National Assessment (ANA) testing in Mathematics Grade 6. The ANA testing in Mathematics and Literacy in our schools has raised serious questions about the current South African education system. Three schools in the Umlazi district that performed well continuously for the past three years in ANA were sampled, together with four teachers from these schools who are teaching Mathematics at Grade 6 level. The data was collected through individual interviews and document analysis. The finding of the study revealed that there are complex factors that contributed to the increased performance of learners, namely the teacher content knowledge, learner‟s attitudes and the school ethos. The conclusions drawn from the themes are used to generate several recommendations to improve the performance of all schools in Mathematics.

Spaull (2013b) has compared the Mathematics results of Grade 6 learners across four countries within Africa. He argues that the South Africa schooling system is failing its citizens, especially the youth of South Africa. The performance in Mathematics and Literacy has been amongst the worst in the world for several successive assessments. His analysis shows that the quality of schooling in our schools is failing our learners. However, it is possible that we are being blinded by the general poor performance in Mathematics, to such an extent that we overlook the fact that there are some schools which are consistently performing exceptionally well. It is from this perspective that this study has been motivated, to establish what factors in the sampled schools contribute to their consistent good performance in the ANA testing and how these factors maybe be emulated in other schools to improve or increase performance.

LIST OF ACRONYMS AND ABBREVIATIONS

ANA	Annual National Assessment
CAPS	Curriculum Assessment Policy Statement
CEO	Chief Executive Officer
DBE	Department of Basic Education
ECLS	Early Children Longitudinal Study
GET	General Education and Training
IEA	International Evaluation of Education Achievement
KZN	KwaZulu-Natal
LOLT	Language of Learning and Teaching
MTSF	Medium Term Strategy Framework
NCS	National Curriculum Statement
NDP	National Development Plan
NGO	Non-government
NSC	National Senior Certificate
OBE	Outcome Based Education
PIRLS	Progress in International Reading Literacy Study
RME	Realistic Mathematics Evaluation
RNSC	Revised National Curriculum Statement
SACMEQ	Southern and Eastern Africa Consortium for Monitoring Educational Quality
TIMSS	Trends in International Mathematics and Science Study
UKZN	University of KwaZulu-Natal
ZPD	Zone of Proximal Development

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CHAPTER 1

BACKGROUND, FOCUS AND RATIONALE

1.1 Introduction

World rankings, learner performance and quality of school education have, for the last decade, come in vogue within South Africa‟s education discourse. Media hypes together with consistent curriculum reviews and revisions of the school curriculum bear testimony to this heightened concern for the provisioning of quality school education. Currently, South Africa participates in two international studies and one regional study focusing on Numeracy and Literacy. These are the Progress in International Reading Literacy Study (PIRLS) and Trends in International Mathematics and Science Studies (TIMSS), and the regional one being the research study of the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ). Within the country, the Annual National Assessment (ANA) is conducted annually to provide a sense of the health of our school systems. These studies and surveys are conducted with a common aim of improving the quality of education within our school education system. Numeracy and Literacy have been selected as the vehicle to examine the quality of education, as these subjects have been deemed to be gateway subjects (D.o.B. Education, 2011).

The Department of Basic Education (DBE) is addressing underperformance and therefore there has been introduction of workbooks and the Curriculum Assessment Policy Statement (CAPS). Action Plan to 2030 and implementation of ANA are initiatives in the right direction for the improvement of the education system of South Africa. The (D.o.B. Education, 2011, p. 10) stated that the purpose of the ANA programme “is to make a decisive contribution towards better learning in schools.” Critical aspects were identified at district and school levels, such as: ANA should assist district officials to support schools, ANA should encourage the involvement of parents in the improvement of the learning process and that ANA should encourage educators to use the required standards and methods in the assessment of learners during teaching and learning.

All public schools and independent schools that are subsidized by the government write ANA. The schools in South Africa write nationally set question papers from Grade 1 to 9 in Mathematics and Literacy. All learners throughout the country write at a specified time as per national timetable. The country is now aware of its strengths and weaknesses and is implementing strategies to improve Mathematics and Literacy through these assessments.

1.2 Background and outline of research problem

The President of the Republic of South Africa, in his 2010 state of the nation address, mentioned the standardized testing in Grade 3, 6 and 9, alluding to the announcement of the first priority of the country, which is to improve the quality of education, (D.o.B. Education, 2011). He mentioned standardized testing, "in order to ensure the validity of the results obtained from the school system and also to inform planning and to produce reports that provinces and districts could use to target schools for different kind of support" (D.o.B. Education, 2011, p. 10). He further set the improvement target of 60% levels of achievement in Literacy and Mathematics by 2014 in response to the performance of learners, which is below the expected standard. Standardized testing within our national school testing was through the ANA. This instrument is a central assessment tool for tracking and supporting leaner progress as stated in the Education Plan 2014, towards the Realisation of Schooling 2025, and in the sector plan for basic education in South Africa. Therefore, all public schools (mainstream and qualifying special schools) with Grades 1 – 6 and 9 in the province and national at large are required to write ANA.

It is within the world of regional and national assessment processes and outcomes that this study is conceptualized. There have been mixed reactions to all of these studies, both in the form of assessment and the outcomes of the assessment (Spaull 2013b). Some researchers like Pausigere and Graven (2013) suggest that the nature and form of these assessment tasks are not appropriate for our national school education system, while others like Fleisch (2008) and Naidoo (2012) question the performance level of our learners within these testing situations. It is with the latter focus that this study has been conceptualized. There have been some increases in performance across the years of assessment within South Africa. This study attempts, therefore, to explore how and why such improvement has come to be within selected schools, that have been identified as showing such improvement, with a view to

exploring enabling factors that could contribute towards improving our learner performances in international, regional and national testing.

The TIMSS is a cross-national assessment of the Mathematics and Science knowledge of Grades 4 and 8 learners, conducted by the International Association for the Evaluation of Educational Achievement (IEA) since 1995 and is conducted in a four-year cycle. The TIMSS is viewed as an opportunity to assess and benchmark South African Mathematics and Science performance in a global context. The last TIMSS conducted was in 2011, which is the focus of the Mathematics results. The TIMSS uses a mean score of 500 as an acceptable level of performance with a standard deviation of 100 points. The 2011 South African TIMSS scores were 352 and 332 for Mathematics and Science respectively. The results of the 2011 study showed a significant improvement from that of 2002 since the 2007 study did not take place. The Mathematics result for 2002 was 285 while the one for Science was 268. The province of KwaZulu-Natal is recorded as the province that has made remarkable improvement. The KZN Mathematics scores improved from 278 in 2002 to 337 in 2011, while the Science scores improved from 253 in 2002 to 308 in 2011. This showed an improvement of 59 and 55 points for Mathematics and Science respectively.

The KwaZulu-Natal (KZN) province participated in the 2002, 2007 and 2013 SACMEQ. IN the year 2013 SACMEQ was written in August and consequently the results are not yet available. Hence, the discussion in this report is confined to SACMEQ II and III studies conducted in 2002 and 2007. The KZN provincial mean scores were 517 and 510 in 2001 for Reading and Mathematics respectively. In 2007 the mean scores were 486 for Reading and 485 for Mathematics, which were below the SACMEQ‟s benchmark of 500. Nevertheless, three districts (Amajuba, Umlazi and UMgungundlovu) performance above the benchmark in both Reading and Mathematics in 2007.

It is evident that there has been an increasing performance in ANA Grade 6 in Mathematics at national, provincial and district level. Nationally in 2012, Grade 6 Mathematics performance was at 27%, in 2013 was at 39% and 43% in 2014. This shows an increased performance in Mathematics. In KZN, the results indicate the following: 2012 – 28%, 2013 – 41.2% and 2014 – 43.8%. This has now motivated that a study should be done to explore the factors, which contribute to the increasing performance in ANA results in Mathematics Grade 6.

This study can contribute to the assistance of underperforming schools in the province regarding Mathematics.

Having established the focus of this study, this chapter then presents an overview of the study by presenting the research purpose, rationale for doing this study, the research questions that this study will attempt to answer and a brief synopsis of the methodology and limitations.

1.3 Purpose of the Study

The purpose of this study is, therefore to explore the factors that influence increasing performance in ANA testing at Grade 6 in Mathematics in selected primary schools in KwaZulu-Natal. As the study attempts to concentrate on increasing performance, schools that have been identified as having an overall increase in performance across the testing years will be selected, with a view of identifying what factors contribute not only to improved leaner performance, but also to identify what keep the school on the improvement track. Schools in KZN have been delimited for this study due to scope, scale and convenience of conducting this research project for the Masters qualification. A further delimit of this study relates to the selection of Grade 6 Mathematics for reasons mentioned above.

1.4 Research questions

The research questions that this study attempts to answer are:

1. What are the factors that influence the increasing performance in ANA testing at Grade 6 in Mathematics?

2. How do these factors positively influence the performance in ANA testing at Grade 6 Mathematics?

3. What explains the influence of these factors on performance in ANA in Grade 6 Mathematics?

1.5 Clarifications of concepts

1.5.1 Mathematics

"Mathematics is a language that makes use of symbols and notations to describe numerical, geometric and graphical relationship. A human activity involves observing, representing and investigating patterns and quantitative relationships in physical and social phenomena and between mathematical objects themselves. The mathematics helps the developmental processes that enhance logical and critical thinking, accuracy and problem-solving that will contribute in decision making (D.o.B. Education, 2011).

1.5.2 Annual National Assessment (ANA)

Annual National Assessment "is a testing programme that requires all schools in the country to conduct the same grade specific Language and Mathematics tests for Grade 1 to 6 and Grade 9 (Modisaotsile, 2012).

1.5.3 Grade 6

This is the last grade in the intermediate phase (Grades 4 – 6) which is in the General Education and Training (GET).

1.5.4 Assessment

Shohamy (2014) defines assessment as any procedure or activity that is used to measure the attitude, skills and knowledge of learners in schools. This is supported by Hanna and Dettmer (2004) when they state that assessment is a process of gathering data used by instructors about their teaching and learning in their learners. This will assist in evaluation of the learners" performance.

1.6 Rationale

My own experience as a departmental official at the Provincial Examinations office involved in the conducting of ANA at provincial level has prompted me to undertake this study. My intention, through this study, is to identify and analyse the factors that influence cause certain schools to show an increase in the test results at Grade 6 level. The results can be shared with other schools of the same or different status with the hope of having an increase in such centres too. It is hoped that the identification of these factors will assist in providing guidance to underperforming schools and to share good practices even with performing schools, in order to maintain high performance and quality in the ANA tests.

This study also has national interest. Drawing from the President‟s (2011) speech, and DBE resolve to provide quality school education, this study will contribute to this national goal by identifying and examining the factors that contribute towards enhancing performance in learner achievement in ANA testing. By identifying these factors and exploring how these factors contribute towards ANA testing improvement, this study would, therefore, be able to contribute to the pool of possible solutions for addressing low performance levels in ANA testing. Some researchers like Spaull (2015) indicate that little or no progress has been achieved in ANA testing. However, there is evidence of improvement in the ANA test results over the last three years (D.o.B. Education, 2014).

There are strong debates on the purpose of national and international testing. Some authors, like Kohn (2000, p. 84), suggest that national and international testing are designed for access issues and such that he referred to standardized testing as “a creature in one of those old horror movies” which demanded schools to be held accountable (D.o.B. Education, 2011), while others, such as Herman and Golan (1993), believe that these tests are designed to establish the health of the education systems. Within the South African system, the ANA testing is largely viewed as a tool to establish benchmarking in the education system (D.o.B. Education, 2011). However, within this view, there are completing arguments relating to the values of these tests, Spaull (2013a) & Kohn (2000) the appropriateness of these tests and understanding and implications of the results of the tests (Spaull, 2013b). This study relates to the third group of arguments where issues about the understanding, implementation, outcomes and implications of ANA are debated across the stakeholders in school education.

More specifically, this study contributes towards further understanding of the outcomes of the ANA testing by contributing to the knowledge base on improving learner performance in national testing. Most schools that are in quintiles 1 to 5 are still performing under the expected benchmark. Some schools are performing at an increasing level and constantly maintain high levels and the DBE can assist in sharing some factors that assisted the high performing schools to uplift the standard of low performing schools.

Kamens and McNeely (2010), Greaney and Kellaghan (2008, p. 45) state that, "many countries have used national assessment for entry to further education." Postlethwaite and Kellaghan (2008 p. 93) argue that, "currently, national and international programmes are mainly used to monitor and evaluate the quality of student learning outcome and are designed to enable comparison over time." According to Postlethwaite and Kellaghan (2008, p. 94), "the national and international assessments are designed to be standardized cognitive assessments which provide evidence about the level of student achievement in identified curriculum areas."

The study acknowledges that there are many more schools in other districts that showed an increasing performance in Mathematics. The research, therefore, is aimed at establishing the factors that contribute to the improvement of performance in Mathematics at Grade 6 as determined by the ANA testing by exploring what happens in schools that have shown such improvement in performance.

1.7 Methodology of the study

The research study is qualitative in nature and falls under interpretative epistemology. The interpretive paradigm is aimed at identifying the experiences through meaning that different individuals allocate to them. The interpretive paradigm will allow me to gain an understanding of factors that contribute to the improvement of performance in Mathematics Grade 6. Krauss (2005, p. 760) stated that a qualitative approach "is based on a relativistic, constructivist ontology that posits that there is no objective reality. Rather, there are multiple realties constructed by human beings who experience a phenomenon of interest." The qualitative approach was deemed appropriate to this study, as the aim of this study is to identify the factors that contribute to the improvement of performance in Mathematics Grade

6 as determined by the ANA testing by exploring what happens in schools that have shown such improvement in performance, in KwaZulu-Natal schools, specifically Umlazi District.

The research will follow a case study methodology. According to Murray and Beglar (2009, p. 48), a case study is "an in depth study of a specific individual or specific context or situation." They further maintain that the real strength of the case study method is "its potential to illuminate a case in great depth and depth and detail and to place that case in real context." A case study according to De Vos, Strydom, Fouche, and Delport (1998, p. 79), lends itself to an interpretative paradigm and its aim is to understand the meaning that people attach to their everyday situation. The choice of taking on a case study methodology is located within the focus of my study, where I attempt to understand the factors that contributed to the improvement of performance in Mathematics Grade 6 ANA results with the operations and systems of the school context. This bounded school context would be able to provide useful information that could explain the reason for this increase in performance. As this study takes on a ground approach, a multiple case study methodology will be used where the sites of research are 3 primary schools. The use of multiple case studies will allow me to delve into the relationships between what happens within each school and performance in Grade 6 Mathematics through the ANA testing with a view to analytic generalization, rather than statistical generalization.

Interviews, observation and document analysis were used as data gathering instruments. Purposive sampling was used in this study. The Umlazi district was chosen because of its diverse nature and uniqueness, having 5 quintiles in one district and that this was one of three districts that performed well in SACMEQ, which was above the benchmark of 500. The sampled schools have had an increasing performance in ANA for three consecutive years. All these schools are in urban areas and in quintile 5. Participants were chosen from 3 schools. The sample constituted teachers who are teaching Mathematics in Grade 6 from each school. Thus, in total, the sample constitutes four participants.

Data Generation

1. Data analysis

Qualitative data analysis encompasses making sense of the data in terms of the participants‟ "definition of the situation, noting patterns, themes, categories and regularities" (L. M. Cohen & Morrison 2007).

2. Trustworthiness

According to Lincoln and Guba (2013) and Maree (2007), trustworthiness refers to the manner in which the researcher can convince the readers that the findings in the study are of high quality and can thus be trusted.

3. Ethical consideration

The necessary permission was obtained from the KwaZulu-Natal Department of Education and from the principals where the research took place and the teachers were interviewed. The participants were assured of anonymity, and research ethics were explained to the participants before information was requested from them during the interviews.

1.8 Limitations of the study

Five schools were initially identified as sample schools. During the course of the research two of the schools withdrew. I remained with 4 participants for interviews. Some participants refused to be audio recorded because of their privacy. Because this study only captured a particular setting out of a large range of settings related to this study, it therefore cannot be generalized to a large target group. Lastly, most teachers (the participants) found it difficult to set aside time for the research interviews due to the heavy workload of their daily routines, e.g. marking and extra-mural activities in school.

1.9 Chapter Summation

The background to the study, the descriptive title, the focus and purpose of the study, the rationale, the objective of the study and critical questions outline are provided. In chapter 2, the study will be located in a theoretical framework through a literature study. In the next, chapter the research design and methodology will be explained. In chapter 4, I will give an analysis of the results, discussions that emerged from the research study. In next and final chapter, I will offer summaries, the conclusions, the recommendations and the value of this research.

CHAPTER 2
LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

In recent years the international rankings, national assessment and standardized testing for education in particular have been the focus of much discussion in the educational and political discourse, with the intention to highlight and promote the educational system in different countries. Located within the Literacy and Numeracy debates across the globe, national assessments seem to be the instrument through which countries become aware of the health of their respective education systems. International rankings of countries‟ school performance, especially in Mathematics and Language Literacy, seem to have been the indicators of relative performances of school systems.

In South Africa, the introduction of the ANA has become that tool to provide the indicators of the health of our education system and through which its world rankings have been constructed. In this Chapter I, therefore, present a landscape of the literature on ANA with a view to understanding its genesis and issues around national assessments. As the focus of this study is on understanding the improved school performance on ANA in Mathematics at Grade 6 level, the literature review in the second half of this chapter will focus on teaching and learning Mathematics at primary school with the intention of exploring the link between competence in school Mathematics and competence in national testing in Mathematics. The chapter concludes with a theoretical gaze that attempts to locate and guide the study through its data collection process and its analytical process.

Education systems across the world are directed through politics and plans. It is therefore necessary to present in this literature review a summary of the policies and plans that are directing school education in South Africa. Hence, this chapter commences with a synopsis of the Action Plan to 2014, a roadmap that intends to direct school education up to 2025.

2.2 Action Plan to 2014: Towards the realisation of schooling 2025

The Basic Education sector plan, Action Plan to 2014: Towards the Realisation of Schooling 2025 has become the roadmap against which the schooling system has set itself strategic targets to achieve. This plan was developed by the DoE (2011), specifically for public schools in order for it to give details on the different challenges facing the educational system and to provide new interventions to deal with the challenges. The most obvious challenge that this plan is responding to is the continual underperformance of learners in South African public schools despite great strides having been made to improve the quality of teaching and learning. Some of the challenges that still persist in school education are poor infrastructure, high teacher-learner ratio in classes, inadequate subject knowledge and poor on-going professional development of teachers despite having a well-developed teacher development framework, Department of Higher Education, (2011).

However Bransford, Brown, and Cocking (2000, p. 41) stated that, "professional development must think of teachers as learners and construct on their knowledge, skills, and beliefs, focus on knowledge and practice, provide opportunities for feedback, revision, and success, and require interactions with others Susan, Love, Stiles, Mundry, and Hewson (2003) believe that most professional development programmes do not succeed because they fail to consider teacher"s experience, needs, background, beliefs and knowledge.

In order to develop an effective developmental programme, Chval, Abell, Pareja, Musikul, and Ritzka (2008 p. 1269) felt that it is crucial to assess and identify the professional developmental needs, constraints and expectations of the province or country. This demands that differentiations amongst educators be considered. For example, novice teachers have different educational needs from veteran educators and professional development needs for an urban educator vary from those of a rural educators. They stated, "One method of designing and developing a program of professional development is to align the activities, pedagogy, and curriculum with standards and assessments adopted by the state or district and to coordinate funding with other programmes in the state and district to develop a coherent professional development reform strategy."

Van Driel and Berry (2012) noted that professional development experiences that focused on subject matter and knowledge of learners have a more positive impact on student learning than those that focused on teaching behaviours. The findings of the study conducted by Chval et al., (2008) declare that teachers are in favour of professional development that is specific to their grade level, content, and classroom practice. This means that professional development needs to be in line with the specific grade levels together with the instruction and learner thinking.

The DBE stated that the purpose of the Action Plan is to "communicate evidence on the nature these challenges and what solutions appear to work for as wide an audience as possible". The Minister of Basic Education (AM Motshekga) stated that "this momentum is driven by a number of promising initiatives that began in recent years, including the Foundations For Learning campaign, improvements made to the National Curriculum Statement, the ANA, the national workbooks initiative, phenomenal expansion of grade R and concerted efforts to improve the Grade 12 pass rate" (p. 3). The Action Plan has 27 goals: goals 1-13 deal with the output that the system wants to achieve regarding learning and enrolment while goals 14-27 deal with the ways in which the outputs will be achieved. This Action Plan is aimed at managers in the education system and those officials who are involved in monitoring progress in the system. Goals 2 and 8 speak about the learner performance in Numeracy and Mathematics. Only two goals from the group 1-13 goals are pertinent to the study. See below each goal explained.

Goal 2

Increase the number of learners in Grade 6 who, by the end of the year, have mastered the minimum language and Mathematics competencies for Grade 6.

Goal 8

Improve the average performance of Grade 6 learners in Mathematics.

Goals talking to aspects that can be done to improve Mathematics and Numeracy are goals 14 to 27. The latter goals are the challenges that the country needs to face and address in realizing some of these goals. These explications to national testing through ANA with the view to identify things that need to be done or challenges that the system needs to face and

address in realizing some of these goals can assist in improving Mathematics and Numeracy in schools at all grades. This study addresses the consistent increasing performance in schools in Grade 6 Mathematics and the analysis of the data collected can assist in addressing the reason why some schools under perform. Goals 14 to 27 below outline the strategies required to realise goals 1 to 13:

Goal 14

Attract a new group of young, motivated and appropriately trained teachers to the teaching profession every year.

Goal 15

Ensure that the availability and utilization of teachers are such that excessively large classes are avoided.

Goal 16

Improve the professionalism, teaching skills, subject knowledge and computer literacy of teachers throughout their entire careers.

Goal 17

Strive for a teacher workforce that is healthy and enjoys a sense of job satisfaction.

Goal 18

Ensure that leaners cover all the topics and skills areas that they should cover within their current school year.

Goal 19

Ensure that every learner has access to the minimum set of textbooks and workbooks required according to national policy.

Goal 20

Increase access amongst learners to a wide range of media, including computers, which enrich their education.

Goal 21

Ensure that the basic annual management processes take place across all schools in the country in a way that contributes towards a functional school environment.

Goal 22

Improve parent and community participation in the governance of schools, partly by improving access to important information via the e-Education strategy.

Goal 23

Ensure that all schools are funded at least at the minimum per learner levels determined nationally and that funds are utilized transparently and effectively.

Goal 24

Ensure that the physical in fracture and environment of every school inspires learners to want to come to school and learn, and teachers to teach.

Goal 25

Use schools as vehicles for promoting access to a range of public services amongst learners in areas such as health, poverty alleviation, psychosocial support, sport and culture.

Goal 26

Increase the number of schools that effectively implement the inclusive education policy and have access to centers that offer specialist services.

Goal 27

Improve the frequency and quality of the monitoring and support services provided to schools by district offices, partly through better use of e-Education.

In 2012, the government adopted the National Development Plan to provide a long-term view of government planning. It is the purpose of the Action Plan to guide those officials in the monitoring progress in the schooling system and for the educational researchers to scrutinize patterns and trends. The National Government‟s cost-cutting strategies and priorities such as those in the Medium-Term Strategy Framework (MTSF), New Growth Path, Industrial Policy

Action Plan, and Strategic Plan as well as other relevant plans come together under the National Development Plan (NDP).

The objective of the Action Plan to 2014 has been influenced by the National Development Plan (NDP). The NDP is divided into 13 chapters that deal with the challenges facing the country and provides solutions to these challenges in the shape of actions and proposals. Chapter 9 of the NDP deals with improving education, training and innovation. Motsekga (2012) stated that he action plan will assist the education section to plan in a way that is more disciplined, professional and accountable as it guides their actions. In order to support the NDP, section 5 of the action plan portrays ANA as a tool for support and monitoring activities described in the action plan. The continual testing of ANA annually in different grades can assist in the growth and development of Mathematics as learners are put through a national test, which identifies skills and attitudes of learners. The new curriculum policy of Curriculum Assessment Policy Statement (CAPS) is a process to achieve the development goals of the NDP.

The introduction of CAPS and ANA has led to the need for better evidence-based planning and practices to raise the performance of learners in Mathematics. The curriculum of this country therefore aims to ensure that learners gain and apply knowledge and skills such that they are meaningful to their lives (D.o.B. Education, 2012). This has compelled the country through its Action Plan and NDP to develop assessment systems for monitoring performance and improving the quality of education in schools (Kanjee & Sayed, 2013). ANA is one of the assessment systems with the aim of improving the performance of learners in Mathematics and Literacy.

2.3 Curriculum policy framework for South African schooling system

Since democracy, there has been several iterations of the Outcomes Based Education (OBE) policy that the South African school system adopted. These include the C2005 iteration, which focused on learner outcomes and assessment criteria to establish intended learning and assessment of the learners. The next iteration of OBE was that of the Revised National Curriculum Statement (RNCS) followed closely by the National Curriculum Statement (NCS) as curriculum policy for school education. This iteration was informed by the

critiques for example, (Jansen, 1998) and C2005 review (Chisholm, 2005) in order to offer a much simplified version of OBE. The final iteration is that of the CAPS, now in its fourth year of implementation. The focus of this iteration of the OBE curriculum philosophy is on content teaching that is guided by a teaching and assessment structure that determines what content is to be taught at what time during the year, how long one should take to teach the content, how it should be taught and how it should be assessed (D.o.B. Education, 2011).

The CAPS policy dictates that a learner should have attained the skills of developing the correct use of the language of Mathematics, development of number vocabulary, number concept and calculation and application skills, building an awareness of the important role that Mathematics play in real life situations including the personal development of the learner, learning to pose and solve problems, learning to listen, communicate, think, reason logically and apply the mathematical knowledge gained and learning to investigate, analyse, represent and interpret information (D.o.B.Education, 2011).

According to CAPS Grade 6, which is the last grade in the Intermediate Phase Mathematics, has been allocated an instructional time of six hours a week. It focuses on six content areas, namely: measurement; data handling; geometry; number; operations and relationships and patterns, functions and relationships. It also stipulates the detailed focus of the content areas of this grade. According to the (D.o.B. Education, 2011, p. 8) "the teaching and learning of Mathematics aim to develop the following:

- A critical awareness of how mathematical relationships are used in social, environmental, cultural and economic relations;
- Confidence and competence to deal with any mathematical situation without being hindered by a fear of Mathematics;
- A spirit of curiosity and a love for Mathematics;
- An appreciation for the beauty and elegance of Mathematics;
- Recognition that Mathematics is a creative part of human activity;
- Deep conceptual understanding in order to make sense of Mathematics."

Acquisition of specific knowledge and skills necessary for:

- The application of Mathematics to physical, social and mathematical problem;

- The study of related subject matter (e.g. other subjects);
- Further study in Mathematics.

Weighting of Mathematics for Grade 6 is according to the different content areas which contribute toward the acquisition of specific skills. Numbers, operations and relationships constitute 50%. This was done in order to ensure that learners are literate enough when they start the senior phase (D.o.B. Education, 2011). The general content focus involves the development of number sense, which includes, amongst others, the meaning and the relationship between the different kinds of numbers, the representation of numbers in various ways and the ability to estimate and check solutions. In the specific content areas, the learners are expected to recognize and describe properties of operations and numbers. By the end of Grade 6 learners‟ range of numbers are developed and extended to at least 9-digit whole numbers, decimal fractions to at least 2 decimal places, common fractions and fractions written in percentage form.

Patterns, functions and algebra carry a weight of 10% of the subject. In the content area, the learners must attain enough manipulative skills in the use of algebra. It also includes the description of pattern and relationships using tables, expressions and graphs. There must be an extension of numeric and geometric patterns, which focus on the relationships between the terms in a sequence and between the numbers of the term. Studying numeric and geometric pattern bring the development in concepts of variables, relationships and functions, which will assist the learners in describing the rules generating the patterns.

The third content focus includes geometry, which is a study of space and shape, which assists the learners in understanding the pattern, precision, achievement and beauty in a natural way. It weighs 15% of the time allocation. Learners must be to draw two dimensional shapes and make models of three-dimensional objects. Describing location, transformation and symmetry is also crucial in this grade.

Measurement is another content area, which weighs 15%. Its focus is in the selection and the use of appropriate units, instruments and formulae in order to quantify characteristics of events, shapes object and the environment. Learners must be able to make estimate and reasonable measurement and results. This means that learners must, amongst other things,

measure angles, areas, perimeter and volume. Measurement is important as it provides a context for learners to use common fractions and decimal fractions (D.o.B. Education, 2011).

Data handling is the last content area, which constitutes 10% of the Grade 6 Mathematics content. This content area involves asking questions and getting answers in describing events and social, technological and economic environment. It helps in the development of the skills of collecting, organizing, representing, analyzing, interpreting and reporting data. This demands that learners are exposed to a number of contexts for collecting and interpreting data and the range of questions that are posed and answered by the data (D.o.B. Education, 2011).

2.4 The health of the education system

Much research that has been conducted in the country (like PIRLS, TIMSS and SACMEQ) discovered that the learners are performing below most of the international standards in primary schools for Mathematics. They are even below the under-developed and poorest countries on the African continent like Kenya, Swaziland, Tanzania, Zimbabwe and Mozambique, (Spaull, 2013b) and (Te Velde et al., 2010). (Sasman, 2011, p. 2) affirms that "Mathematics is an indicator of the system for most career and job opportunities in this society that is increasingly technological, with demands that an individual must possess a strong mathematical background". She felt that Mathematics "provides learners with the means to describe, analyse and understand their world and to deepen their understanding while adding to the ability to solve real-world problems. As such, mathematics is important for the economy and nation building." This is supported by Pinkney and Shaughnessy (2013) when they maintain that mathematical knowledge creates differences and speediness in the thinking systems of people as it provides meaning to the aesthetic side of different individuals (Ardoin, Clark, & Kelsey, 2013).

Spaull and Kotze (2015) studies the learning deficits in South Africa and how these deficits are located in learners‟ population. The analysed four national datasets of Mathematics, namely TIMSS 2011 in Grade 9, SACMEQ 2007 in Grade 6, systematic evaluation 2007 in Grade 3 and National School Effectiveness Study 2007 / 2008 / 2009. Through analyzing these studies, they discovered that there is a gap in learning between the advantaged learners, who constitute 20%, and the disadvantaged learners, who constitute 60% by three grade-

levels in Grade 3 and escalating to four grade-levels by Grade 9. They concluded that the early intervention in learning deficit can prevent the need for future remedial teaching.

Van der Berg, Taylor, Gustafsson, Spaull, and Armstrong (2011, p. 56) have stated that "all of the datasets have been analysed by academic researchers, policy makers and educational NGO"s yielding a considerable amount of insight into the performance of South African learners, and the generative mechanism behind that performance." Spaull (2013, p. 3) stated that there is an on going crisis in the South African education system as most of its learners are performing poorly in literacy and numeracy. He further mentioned, "South Africa has the worst education system of all middle-income countries that participate in cross-national assessments of educational achievements. As it stands the South African education system is grossly inefficient, severely underperforming and egregiously unfair," It is also evident that learners are performing badly in the country at higher grade from Grade 9 – 12, in Mathematics (Weitz & Venkat, 2013).

2.5 International studies in exploring Mathematics competencies

Internationally, much research has been done on assessment of primary school learners. The research largely seeks to establish the performance of learners so that intervention may be done where there is a need. My research will contribute to the knowledge of factors that influence the increasing performance, how these factors influence the increasing performance and what explains the influence of these factors on performance in ANA in grade 6 Mathematics.

The international reports on TIMMS for reading (Mullis, Martin, Foy, & Drucker, 2012), Mathematics (Mullis, Martin, Foy, & Arora, 2012) and Science (Martin, Mullis, Foy, & Stanco, 2012) give a detailed description of the performance of learners in all participating countries, and relate performance to selected characteristics of learners, parents, class and school environment (Eivers & Clerkin, 2012, p. 1).

Mathematics is not a national crisis but it is an international challenge, (Kuenzi, 2008), (Norris, Stelnicki, & de Vries, 2012) & (Nwabude, 2011). Uribe-Flórez (2009) conducted a study on teacher variables and student Mathematics learning related to manipulative use. She

describes manipulative as tools that are used in the learning process in the classroom. She wanted to examine the potential role in the use of manipulative. She conducted two different studies that were quantitative in nature. The aims of these studies were to examine the relationship between teachers‟ use of manipulative and teachers‟ variable and to scrutinize the relationship between elementary aged students‟ manipulative use and their individual Mathematics learning. She firstly studied the relationship between the variable of the educator and the rate at which educators use manipulative in activities used in the classroom. Her sample constituted 503 in-service elementary teachers coming from two districts that are located in the southern part of the United States.

A survey was completed by the teachers at the start of the professional development programme. The teacher variables used in this study were the teachers‟ age, grade level, experience, interrelationship among these variables and his or her beliefs in the use of manipulative. She analysed her data using a two level hierarchical linear model and graphical techniques and investigated and moderating effects of student home language on this relationship. Her findings were that there was a positive relationship between the frequency of manipulative use and student Mathematics learning.

Her second study was “manipulative use and elementary school students‟ Mathematics learning.” In this study, she examined the relationship between manipulative use and student learning with the Early Childhood Longitudinal Study (ECLS) database. Her research study also wanted to discover if socio-economic status, home language and race ethnicity are possible moderators for this relationship. In examining the relationship between manipulative use and learners learning, hierarchical linear modeling techniques were used. She also studied whether this relationship was moderated by home language or not. The results of this study was consistent with previous research that was showing less use of manipulative in higher grades at the elementary school level. She also discovered there are differences at the primary level as kindergarten teachers were using manipulative more than Grade 1 to 2 teachers, which is different from her previous study. The findings of both the studies give a more comprehensive picture of teacher factors and student outcomes in relation to the use of manipulative in the elementary Mathematics classroom.

Another study was conducted in Indonesia by Fauzan, Slettenhaar, and Plomp (2002) in teaching Mathematics in Indonesian primary schools using Realistic Mathematics Education (RME) approach. The stated that RME is an approach whereby Mathematics is considered as a human activity, like solving everyday daily problems is part of Mathematics. The aim of this research study was to look at the hindrances when teaching using the RME approach and how to overcome these hindrances. Their first experience in implementing the RME approach was in teaching geometry in Grade 4 classrooms. They stated that RME has five teaching and learning principles, namely structuring and interweaving, levels and models, social context and interaction, constructing and concretizing, reflection and special assignment. In these interventions, mathematical concepts should be instilled in learners in a highly interactive teaching and learning process. Teachers were expected to discover ways of obtaining an optimal result as RME is taken as an approach that will change the teaching and learning climate of the classroom and make geometry more accessible to Indonesian learners.

Their data was presented in narrative form in order for them to be able to deliver the richness of the processes and interactions that happen during the intervention. The challenges that they encountered were that most of the learners were lacking self-confidence in problem solving such that they were dependent on the teacher and that make it difficult to organize the class as most learners were asking for assistance. They discovered that learners had these challenges as they were used to the traditional way of teaching and learning. These learners were not exposed to working with contextual problems and were never taught in working in groups. They made various efforts to make RME functional, like changing the attitudes of parents and learners, which led to positive changes to learners‟ activity, creativity and reasoning, as witnessed by the teacher.

2.6 Local studies in Mathematics

The studies conducted in South Africa reflect that this country is performing way below expected standards, even lower than poorer countries like Swaziland, Tanzania and Kenya, (Spaull, 2013). The survey indicated that South Africa ranked 10th out of the fourteen education systems for reading and 8th for mathematics, (Spuall, 2013). South African learners participating in the study lacked basic literacy and numeracy skills, rendering them functionally illiterate and innumerate (Shabalala, 2005).

In South Africa the DBE has made the ANA a priority to test literacy and numeracy skills of learners for monitoring and tracking achievement of goals set in the DBE Action Plan (D.o.B. Education, 2011). The ANA, introduced in 2011, aims to expose teachers to better assessment practices, help districts to identify schools most in need of assistance, and inform parents about their children‟s performance (D.o.B. Education, 2011). More recently and noting the concerns raised about the number and quality of matriculation passes of learners, another form of national testing has been introduced into the school education system. These tests are in the form of ANA that assesses learners‟ competences in literacy and numeracy in grades 3, 6 and 9. Based on this test analysis and benchmarking on a global scale. Spaull, (2011) suggests that we have a two-school world in South Africa, one that is for the poor and located across schools in the lower quintile ranking (quintile ranks 1, 2 and 3) and one that is for the more affluent (quintile ranks 4 and 5). The lower quintile rankings are consistently performing poorly in the ANA testing, while the higher quintile ranking schools are performing relatively better than the lower quintile ranking schools.

Shepherd and Öberg (2013) used a nationally representative dataset of Grade 6 learners in South Africa. She used test scores for English and Mathematics to identify learner performance across subject. She estimated teacher knowledge to have a positive influence on performance in wealthy quintile. She discovered that strong subject matter knowledge and understanding is crucial as it has a positive impact in transferring the information meaningfully to learners. In her study, she used the data from the SACMEQ survey conducted in 2007. Her study constituted a sample of 9083 Grade 6 learners from 392 schools in South Africa. She was exploring learner knowledge in Literacy, Numeracy and Health. She used standardized multiple questionnaires for data collection, where teachers were expected to conduct their health test together with their subject specific test but teachers were expected to answer additional challenging questions. The Rasch scaling was used in transforming teachers‟ scores. The findings of her study reveal that even though strong knowledge and understanding of the subject matter are crucial, she felt that the ability of the teacher to transfer that information in a fruitful way is more crucial. She further concluded that in explaining learner performance differences in the quality of teacher training and development in pedagogical skills.

Another noteworthy local study is the one conducted by Pausigere (2013) on analyzing primary Mathematics teachers‟ position and identities using Bernstein‟s notions of pedagogical identity. They used interactive interviews to gather data from four primary schools Mathematics teachers who were participating in Numeracy in a service education community of practice. Purposive and stratified sampling was used to select the four teachers as it was supposed to be those who were prepared to be part of the longitudinal study. They used four teacher positions out of the eight identified by Morgan (2006) that they found relevant to their study, namely examiner using external determined criteria, teacher-advocate, teacher-pedagogic and interested mathematician. They discovered that primary Mathematics teachers reported that their teaching is influenced in different ways by the ANA tests. They finally recommended that primary Mathematics teachers have to be assisted in ways of „critically aligning‟ their practices in order to match the national policy.

2.7 Effective teaching of Mathematics considering learners' informal knowledge

Apple (1992) discussed mathematics teachers‟ work from a political and economic perspective. A subject such as mathematics is seen as an economically useful subject to create a better workforce that is economically viable for the country (Apple, 1992). In South Africa, Amin (2012) argues that Mathematics is linked to national development. South Africa participated in the TIMSS with 61 other countries and in which South Africa was Ranked 62nd (Howie, 2003).

Shulman (1986b) in his seminal work on pedagogical content knowledge (PCK) pointed out that in order for teachers to practice effective teaching, they need to possess knowledge of the subject matter because it is crucial and central to effective teaching. Atweh, Becker, Grevholm, and Subramanian subscribe to Shulman‟s notion by stating that effective teaching can be achieved by connecting teaching instruction to the context of learners and by affording learners opportunities to explore interactive numeracy activities, which promote learners‟ development. Opdenakker and Van Damme (2006) also maintain that apart from the positive interdependent relationships, which contribute to effective teaching of numeracy, learners‟ centered teaching style is also being promoted. Committee (2001) further indicates that effective teaching of numeracy depends on interdependent interaction between numeracy content, teachers‟ devotion to work with learners and the involvement of learners in numeracy activities.

Henning and Kovacs (2014) pointed out that teachers should know that humans are born with core Mathematical knowledge situated in each individuals‟ brain. As a result, they should teach learners real numeracy content, not only counting, because this helps learners‟ inborn Mathematical knowledge to develop. Henning and Kovacs (2014) states that all children in the universe are born with the concept of „three‟ and magnitude. She indicates that at infancy stage, children are able to differentiate between „one‟ and „more‟.

Greenes, Ginsburg, and Balfanz (2004) discover that learners informally learn various numeracy concepts. As a result they need to be exposed into a broad content of numeracy like space, shapes pattern, number and operations. (Ginsburg, Lee, & Boyd, 2008) argue with Henning (2014) that children from birth to age five develop an everyday numeracy including informal ideas of concepts like more, less, taking away, shape location and positions. Committee (2001) indicates that effective teaching of numeracy assumes many different shapes because it is teaching, which focuses on fostering and maintaining the development of numeracy proficiency over time.

Therefore, it is clear that effective teaching relies on the quality and quantity of interaction between the content, teacher knowledge of the content and teachers‟ involvement with learners. However, in order for teachers to practice effective teaching they need to have common content knowledge (CCK) and knowledge of student and content (KSC) (Deborah Loewenberg Ball, Thames, & Phelps, 2008). This knowledge will help them to present thoughtful numeracy lessons, which accommodate all learners and respond to their differences in terms of their abilities, needs, and backgrounds (Learning Study Committee, 2001).

2.8 The teachers' pedagogical content knowledge for the teaching of Mathematics

The teachers are, and have been, the main focus of schooling systems around the world. The teachers have been part of the education system; the quality of a country‟s teachers is intimately related with the quality of its education system. Deborah L Ball and Bass (2000) in exploring the content knowledge needed for teaching numeracy, focused on analyzing the actual teaching practice of numeracy. Their analysis concentrated on the role played by content knowledge. The findings exposed that the practice entails different kinds of

knowledge because it affords them an opportunity to incorporate practices like understanding and interpreting learners‟ responses, anticipating uncertainties, challenges which might occur during the teaching and learning process, deciding on how to present the content and to modify the curriculum, materials and instruction.

Shulman (1986b) indicates that possessing knowledge of the facts and concepts of the subject matter alone is insufficient. The teachers should retain adequate knowledge of the subject matter and be able to demonstrate an understanding of why a certain topic is central in subject matter while others are less so. This helps them to make informed decisions in terms of their teaching (Shulman, 1986b). Clements (2001) supports Shulman‟s point of view by pointing out that numeracy for Grade R learners is broad. It is beyond the mere practice of counting and adding. Therefore, to deliver effective mathematical instruction, teachers need to have a sound content knowledge and pedagogical content knowledge (Shulman, 1986b).

“The available evidence suggests that the main driver of the variation in learners‟ learning at school is the quality of the teachers, and thus that the quality of an education system cannot exceed the quality of its teachers” (Barber & Mourshed, 2007, p. 12-41). However, determining the quality of teachers can be a tricky process, with any single definition bound to disappoint different types of people depending what their understanding is of a quality teacher.

Nevertheless, for the purpose of this study a quality teacher is someone who possesses the following four attributes in no particular order:

- Some requisite level of professionalism (values);
- The inclination to teach (attitudes and desires);
- The ability to teach (knowledge, skills and pedagogy), and therefore;
- The competence to teach (imparting and instilling the knowledge, skills and values learners should be acquiring at school).

It is clear that teachers must possess attributes one to three if they are to be a competent teacher. The distinction between content knowledge and pedagogy has been explored extensively in the literature, starting with Shulman‟s (1986) seminar paper introducing pedagogical content knowledge, and extending to the more recent discussion of „„ontent knowledge for teaching‟ (Ball, Thames, & Phelps, 2008), both of which combine elements of

content knowledge and pedagogy in interesting and important ways. However, most studies assume that teachers already have the basic content knowledge which they are expected to teach, and thus the real question is whether they can convey that knowledge to their learners or how much more they need to know. For example, in Ball et al., (2008, p. 4) in a discussion of Mathematical content knowledge for teaching they explain that:

> "By this phase (Mathematical content knowledge for teaching), we mean the Mathematical knowledge that teachers need to carry out their work as teachers of Mathematics. Obviously, teachers need to know the content they teach and that learners are expected to master".

Hill, Rowan, and Ball (2005) in their study about „The effects of teachers" Mathematical Knowledge for Teaching on Students" Achievement", concluded that there is a relationship between teachers" Mathematical knowledge and learners" achievement. The study specified that teachers" knowledge for the teaching of numeracy has a positive influence on learners" gains in grade one to three Steele (2013) in their study titled „Mathematical Knowledge for Teaching and the Mathematical Quality of Instruction" support the relationship identified by Hill et al., (2005) by signifying that "there is a powerful relationship between what a teacher knows, how she knows it and what she can do in the context of instruction" (Hill, et al., 2008, p. 496).

Hill, et al., (2008) emphasis that their participants in the study, with high knowledge of content were able to present quality instruction because they skillfully responded to learners" questions, they provided rich mathematical examples, they ensured that all learners were afforded equal opportunities to learn and were able to contextualize the numeracy content.

Some studies suggest that teachers find standards and assessments helpful for focusing their instruction and obtaining feedback about the effects of their instruction Mabry, Poole, Redmond, and Schultz (2003), but other studies indicate that at least some teachers do not perceive tests as instructionally useful (Harlen & Deakin Crick, 2003). It is not entirely surprising that teachers do not always find tests useful as Linn, Baker, and Betebenner (2002, p. 3) points out, "such tests are more suitable for providing global information about achievement than they are for the kind of detailed information that is required for diagnostic

purposes." In addition, many teachers believe large scale tests are poor measures of students" skills and knowledge, particularly in the case of special education students and minority students (Pedulla, et al., 2003). This is supported by Black and Wiliam (1998) who recognize that standardized tests are very limited measures of learning.

"In the acquisition of life-long learning skills, learners are exposed to several alternative learning methods and are expected to demonstrate what they have been able to acquire in different ways through assessment" (D.o.B. Education, 2011, p. 6). Therefore, the teacher"s Mathematical knowledge to teach numeracy plays an important role in teaching the subject matters. As a result, teachers must be knowledgeable and competent with both the subject matter knowledge and pedagogical content knowledge in order to practice effective teaching.

2.9 Theoretical framework

Let me present the theoretical framework engaged in this study by demonstrating that in order to understand the practices revealed by teachers teaching Mathematics, I will draw upon the theoretical framework of Piaget and Vygotsky, which is relevant to my study. The theoretical framework will supplement more practices, which teachers should accomplish during the teaching of Mathematics.

ANA is testing the health of our school education system in a recent conception within the South African context, but very little theoretical engagements have been made on ANA testing as well as on improvement of performance, except to trends and patterns taking on a comparative analytic stance. As this study acknowledges that there are noted improvements in performance at some schools in KZN on ANA testing related to Mathematics Grade 6, this study takes on a qualitative gaze to establish factors that contribute to the noted improvement; hence, a constructivist approach is appropriate for this study.

Figueiredo, van Galen, and Gravemeijer (2009) stated that constructivists build their own knowledge in Mathematics by providing learners with appropriate assignments Youngblood, Heierman III, Cook, and Holder (2005) stated that constructivists interpret the environment and the experiences in accordance with the experience and the knowledge they possess. husén and Postlethwaite (1996, p. 11) "define constructivism as a theory of knowledge, which has its origin in cybernetics, psychology and philosophy". They further mentioned that

constructivism has two main principles for cognitive development and learning namely knowledge is actively recognized by building up a subject and that the function of cognition is adaptive and serves the organization of the experimental world. Brooks and Brooks (1999, p. 14) are of the idea that constructivism is not a theory about teaching. Instead they view it as "a theory about knowledge and learning which describe knowledge as temporary, developmental, socially and culturally mediated and thus non-objective." The constructivists believe that children can individually or collectively construct knowledge and meaning in solving problems that they have encountered in their environment without any assistance from any adult. Kanselaar (2002, p. 5) "asserts that this theory entails three aspects, that is, a set of epistemological beliefs, educational beliefs about pedagogy and psychological belief about learning and cognition".

The knowledge that learners build is not independent of the environment and experiences which they come from as is emphasized by (Youngblood, et al., 2005). (Cook, 2012) further talks about how learners interpret the environment and experiences. Their own knowledge in Mathematics is not the main driving force, but is also contextualized within the experiences. The context in which learners function makes it relevant to the type of socialization that happens at the school levels or classrooms where the classroom context provides the context within the environment in which they learn Mathematics.

Wertsch (1991) states that Jean Piaget was born in Neuchatel in Switzerland in 1896 and died in 1980. He developed an interest in the natural worlds and biology, which led to his publication of a number of scientific studies. He obtained his PHD at the University of Neuchatel when he was 21 years old. He investigated children‟s minds and their cognitive development and discovered that social interaction has a positive impact in children‟s cognitive development. He identified four stages of development that everyone has to pass through. These stages are sensorimotor stage, preoperational stage, concrete operational stage and formal operational stage.

Piaget‟s first stage of development is the sensorimotor stage, which is from birth up to two years. He stated that at this stage a child is able to link numbers with objects Piaget (1977) for example one apple, two sweets, etc. Fuson (1991) & Morledge (2012) supported Piaget‟s idea in that at this stage children have developed some understanding of numbers and

counting. Ojose (2008) stated that it is during this stage where caregivers have to lay a solid mathematical foundation by providing children with activities that promote counting and therefore enhance children‟s conceptual development of numbers. He recommended that learners must be given pictorial books with mathematical concepts, which will in turn contribute to the development of reading and comprehension skills.

The preoperational stage is the second stage identified by Piaget and it occurs between 2 – 7 years (Piaget, 1965). Jehan and Butt (2015, p. 13) allude to the fact that "children are missing at this stage able to do one-step logic problems, develop language, continue to be egocentric and complete operations." Piaget believed that this stage is characterized by, amongst other things, the development of language, limited logic and symbolic thoughts. Ojose (2008) believed that teaching learners at this developmental stage requires that teachers must employ effective questioning about characterizing objects. Reedal (2010) affirms that children are capable of solving logical problems in Mathematics but are still limited to the use of concrete materials. In most of Piaget‟s work, children are not in a position to conserve mass, liquid quantity and number.

The concrete operational stage is the third stage and occurs between the ages of 7 and 11 years. Piaget (1965, p. 7) believed that this stage is characterised by the development of mental operations where the operation is "an interiorized, generalized and reversible action". Piaget (1965) stated that serration and classification are developed at this stage and are both crucial for the development of numeracy". Ojose (2008) mentioned that this stage is characterised by cognitive growth and the rapid development of language and basic skills acquisition.

The formal operations stage is the last stage identified by Piaget. Children enter this between 11 and 16 years and continue until their adulthood. It is characterised by logical thinking and abstract thought from understanding abstract concepts where reasoning has to be executed. Anderson (1990) when cited by Ojose (2008, p. 8) stated that "at this stage reasoning skills refer to the mental process involved in the generalizing and evaluating of logical arguments and includes classification, inference, evaluation and application". At this stage children can compare different mathematical situations, which can lead to more complicated mathematical thinking.

Ojose (2008) stated that Piaget‟s work on the development of children has assisted Mathematics educators in gaining crucial insights into the learning of mathematical concepts and ideas. He further mentions that Piaget believed that the development of a child occurs through a continuous transformation of thought processes.

According to the South African admission policy, learners must be aged 11 when doing Grade 6, which is the end of the concrete operations stage and the beginning of the formal operations stage according to Piaget. At this stage the learners are able to think logically and are able to construct their own Mathematics which develops their reasoning and language usage. The learners are able to utilize their own thoughts on the five content areas in Grade 6 Mathematics.

Vygotsky is another constructivist who is relevant to this study. Vygotsky was born in Tsarist Russia and passed away in 1934. Wertsch (1991) stated that in his early years, Vygotsky displayed interests in philosophy, theatre, language history and literature. Like Piaget, Parsons, Vakar, and Hanfmann (1962) thinking was embedded in the idea that a child is an active learner. They are of the idea that social interaction plays a crucial role in the child‟s development and learning. Jones and Brader-Araje (2002) stated that Vygotsky‟s work has leveled the foundation of social constructivism in educational settings especially in the role played by the social context in learning. Vygotsky is of the idea that most learning occurs in the Zone of Proximal Development (ZPD). ZPD is referred to by Vygotsky (1978) as the distance between what a learner can do with assistance and what they are capable of doing without any assistance. Jones and Brader-Araje (2002, p .5) believe that “learning is best understood in light of others within an individual world.” During the learning process the learner is assisted by an expert or adult. Thus, the ZPD is achieved when the learner has been engaged in social learning. For example, in Mathematics, the educator can guide a learner on how to solve a particular solution and later give the learner more complicated solutions to solve where the learner will be successful in finding the correct answer without any assistance.

Boettcher (2007) stated that the ZPD presents the readiness to learn and to perform the given task to a higher degree. She further mentions that children can perform a certain task with

assistance today but later do it correctly without assistance from anyone. Vygotsky also believed that children learn much through play. Therefore, parents and teachers must provide learners with activities that enhance mathematical growth or literacy.

Vygotsky‟s theory assists teachers in the development of a conceptual framework which supports their philosophies of learning and teaching Mathematics (Wertsch, 1991). Smolucha (1992) supported the model of Vygotsky as it creates experience which links learners‟ learning in building confidence in their mathematics. Most of the experiences are gained from the assistance of teachers who influence mathematical knowledge to the learners. Through their assistance, learners are able to do complicated tasks without assistance from the teachers, which are referred to by Vygotsky as the ZPD. I found this model relevant to this study as the increase in Grade 6 Mathematics performance is from the teachers‟ knowledge of the subject and experience in teaching the subject, thus assisting learners to perform better.

2.10 Conclusion

This chapter presented the introduction, Action Plan 2014, the theoretical framework, health of the education system, policy framework, and different literature reviewed assessment. In the next chapter, the research design, methodology and the theoretical framework will be explained.

CHAPTER 3

RESEARCH DESIGN AND METHODS

3.1 Introduction

In the previous chapter, I presented the underpinnings of the research study and the literature review. I discussed the policy framework of the South African education system, the health of the education system, effective teaching of Mathematics considering learners‟ informal knowledge and the teachers‟ pedagogical content knowledge for the teaching of Mathematics I argued that the content knowledge is crucial to understanding how the education system is performing and especially to our system in South Africa after 20 years of transformation.

This chapter presents the research design and research methodology to collect data. Mouton (1996, p. 107) mentions that the development of a research design logically follows the research problem. He defines the research designs as "a set of guidelines and instructions to be followed in addressing the research problem." He further mentions that it is the major function of the research design to permit the researcher to anticipate the appropriate research decisions, which will in turn maximize the validity of the eventual results. In this study, the research design included an interpretivist epistemology, through qualitative case study methodology, using three schools as the sites of research. Interviews and document analysis were the main forms of data production tools. The sections below will then present the research design. The research focused on the factors that influence the increasing performance in ANA testing at Grade 6 in Mathematics. The aim, therefore, of this investigation was to gather information about these factors and how they influenced the increasing performance of learners in the ANA.

3.2 Qualitative research approach

This study is qualitative in nature and situated under the interpretive paradigm. Griffin (2004) stated that this approach focuses on meaning, the way people make sense of the world around them and their experiences of events from their perspectives. McMillan, Schumacher, and Singh (1993, pp. 372-373) describe "qualitative research as a naturalistic inquiry, using non interfering data collection strategies to discover the natural flow of events and how participants interpreted them". This is supported by Srivastava and Thomson (2009) when

they stated that qualitative researchers study events in their natural setting and make attempts at making sense of it or interpret the phenomena in terms of the meanings people provide. Thus, it is concerned with understanding human behaviour in a context in which it occurs to them.

Meaning making is constructed as the researcher converts raw empirical data into what E. Henning, Van Rensburg, and Smit (2004, p. 6) explains as a "thick description". The „thick description" is the end result of a process through which an account of the phenomenon has evolved into an interpretation of the information in light of other empirical data in the same study" E. Henning et al. (2004, p. 6). The concept of meaning making was extended by the research manifesting itself as one with the characteristics of an unfolding, emerging, interpretive approach.

Qualitative research design investigates the "socially constructed nature of reality". Lincoln (2009, p. 13). This social construct is the reality of the lived experiences of the participants. Values, attitudes and opinions are continually communicated and the school cannot be regarded as neutral or as a „value void". The entire educational process continually, consciously or unconsciously, presents certain values to the learners and teachers. Apple (2004, p. 78) refers to these norms and values, the ones that are "implicitly, but effectively taught by schools", as the "Hidden Curriculum." He adds, "They [the norms and values] are not usually talked about in teachers" statements of ends or goals" and qualitative research also seeks to understand those values that are embedded in the context being studies Borg (1993, p. 197). The unfolding research presented clear evidence of the values and norms that the school instilled.

The phenomenon of „there are schools performing well" is one that presents itself in a unique context. The inductive study of the phenomenon presented a deeper understanding of the complexities of school regarding assessment and performance of learners. "The inductive approach presents a relationship between theory and research where the theory is in fact the outcome of the research" (Bramham, 2006, p. 6). Grounded theory, which is summarized by Charmaz (2004, p. 496) as "a set of data collection and analytic procedures aimed to develop theory", is an important part of this study and is therefore an appropriate approach for this study.

The qualitative approach was found relevant to this study as it assisted me in getting an in-depth knowledge on identifying factors that have influenced the increasing performance in ANA of schools in urban areas. Kuru and Sulaiman (2012) stated that the emphasis of a qualitative research is on its naturalistic and interpretative approach which assist in understanding the meaning different people connect to a certain phenomenon that is based on their actions, values, decisions or beliefs within a particular social context.

The choice of using the qualitative approach was also based on the following advantages as cited by authors including Myburgh, Poggenpoel, and Van Rensburg (2004), L. M. Cohen and L. Manion (2007), Marshall and Rossman (2014) and Kirk and Miller (1986)

- Assists in reconceptualising data
- Provides in-depth analysis of experiences, perspectives and understanding of a particular phenomenon.
- Gives flexibility to the researcher to collect data.
- Smaller samples selected purposefully for a specific criterion.
- Ability to communicate with the participants in their own language during data gathering.
- Gathering of data using a number of data collection methods.
- Construction of a detailed description of a meticulous social reality.

Considering the above advantages, this study was able to give findings on the data gathered from participants. The limitations of using the qualitative approach include:

- It is time consuming as it deals with an individual participant.
- It is expensive as it involves traveling costs during data gathering
- Might lead to bias in explaining the phenomena.
- Demands a high level of interpreting the gathered data Mahoney and Goertz (2006) Griffin (2004), and L. M. Cohen and L. Manion (2007), .

A qualitative study conducted by Brunk (2010) was found relevant to the study. Her work was based on discovering teachers‟ attempts of improving instructional strategies for the teaching of Mathematics in an inner city elementary school. She sampled one school with its ten teachers and the learners with whom teachers had experimented the use of instruction strategies. Mathematics teachers in this study employed a number of strategies during their Mathematics period. These Mathematics teachers employed a number of techniques like (1) modeling logical thinking in the use of intervention activities, (2) using manipulates and

number lines during whole-group instruction, (3) focusing on explicit instruction with small groups, (4) engaging students in partner learning and peer tutoring, (5) integrating music, (Asian Social Science April, 2008, p. 63), video cassettes and computer software, (6) working problems from the textbook, and (7) involving the parents by sending home the results of daily mathematics quizzes and by requesting that the parent or guardian oversee Mathematics homework assignments. Through the use of this approach he discovered that the use of different instructional strategies in teaching Mathematics activities during partner learning and peer tutoring. The school also used audio, visual, and kinesthetic modes of instruction; and learners were more attentive during direct instruction. She also discovered that children with parents who supported them and supervised their homework assignments in Mathematics performed better on daily quizzes. She did a pre-test before the research study and a post test after the study. The results reflected that there was an increase of 27 points in the post-test.

The work and findings of Bradley and Corwyn (2002) were relevant to my work as the three sampled schools used in this study were in urban areas and are fully resourced. Teachers used this variety of resources and different strategies in teaching Mathematics with a high level of parental support. These schools continually perform outstandingly in ANA tests that are the results of using different techniques and having varied equipment in teaching Mathematics rather than using the traditional approach of pen and paper to learners and chalk to chalkboard by educators.

3.3 Interpretive paradigm

This study is qualitative in nature and falls within an interpretivist epistemology. Maree (2007) stated that an interpretive research study provide insight on how a particular individual makes meaning or sense of situations that they encounter in their social context. L. M. Cohen and L. Manion (2007) stated that interpretivists consider individuals as their primary sources of data as they study their meanings, behaviours, understandings, interpretations and perceptions of the world around them. Individual knowledge of reality is gained through social interactions like language, documents, consciousness or any other artifacts (Klein & Myers, 1999). In this study, it was the interaction between the researcher and the sampled teachers, who were teaching Mathematics in Grade 6.

The interpretivist tradition presents two different views of meaning. The first view, as described by Schwandt (2001, p. 153) is the "meaning of an action". This "resides with the consciousness of the actor and it was understood "in terms of the actor‟s intentions". The second view is that "action has meaning" (Schwandt, 2001, p. 154). In the search for deeper understanding and meaning, the researcher recognized that the related concepts of assessment, evaluation and standardized testing cannot be manipulated because of systems put into place to ensure that results are credible and reliable. In fact, one does not wish for results to be manipulated because it was "exactly this freedom and natural development of action and representation that we wish to capture" (E. Henning et al., 2004, p. 3).

The use of the interpretative paradigm greatly assisted me in interacting with the research participants, which led to gaining information on discovering factors that led to continually increasing performance in Mathematics Grade 6 ANA. The interpretative paradigm was appropriate to the study by its strengths as stated by (Cohen & Manion 2007) and (Guba & Lincoln, 1994)

- The researcher is fully involved in data collection and analysis.
- Provides greater opportunities to get insight of the problem being investigated.
- Possibility of generating new knowledge.
- Providing valuable information for future practices and studies.
- The researcher work closely with the participants
- The study should be field focused.

3.4 Constructivists case study

The research design selected for this study is a constructivist‟s case study. It comprised of a case study with elements of constructivists theory. In order to fully understand the link between the two, each will be discussed separately.

The reason why I chose a qualitative approach is that "qualitative research methods are the least prescriptive" (Cooper & White, 2012, p. 137). The research will follow a case study methodology. According to Beglar, Murray, and Education (2009, p. 48) a case study is an "in-depth study of a specific individual or specific context or situation." They further maintain that the real strength of the case study method is "its potential to illuminate a case in

great depth and detail and to place that case in real context." A case study according to De Vos et al. (1998, p. 79) lends itself to an interpretative paradigm and its aim is to understand the meaning that people attach to their everyday situations.

The choice of taking on a case study methodology is located within the focus of my study, where I attempted to understand the factors that contributed to the improvement of performance in Mathematics Grade 6 ANA results with the operations and systems of the school context. This bounded school context was able to provide useful information that explained why there is this increase in performance. A multiple case study methodology was used where the sites of research were at 3 primary schools. The use of multiple case studies allowed me to delve into the relationships between what happens within each school and performance in Grade 6 Mathematics through the ANA testing with a view to analytic generalization, rather than statistical generalization.

A case study within a qualitative approach suggests that the „main assumption is that a phenomenon is investigated as a „bounded system" (E. Henning et al., 2004, p. 2). The selection of a case study correlates directly with the research being undertaken. Hardy and Bryman (2004, p. 48) makes the point that "a case study entails the detailed and intensive analysis of a single case." I selected a case study as it focuses on a specific description and explanation of the phenomenon.

The broader context of the CAPS 2012 implementation that was being undertaken at the time of the study places the research in a larger educational context. This case study has elements of constructivist theory. Chiva and Alegre (2005) is of the idea that constructivists build their understanding and knowledge rather than taking in an external reality and develop an unchanged, exact mental copy of objects and events. For the constructivist theory, individuals through the knowledge and experiences they possess interpret the environment and the experiences. The researcher set out with a topic to investigate and that which was relevant was allowed to emerge.

In the following section, the role of the researcher, constructivist case study, data collection process, sampling the site selection and trustworthiness are described.

3.5 The role of the researcher

Gall, Borg, and Gall (1996) stated that the role of the researcher is too complex as s/he becomes the primary instrument. This is also supported by Johansen et al. (2007, p. 7) when they mention that the researcher is "unequivocally the main instrument of the research." Bogdan and Biklen (2003) affirm that qualitative researchers must objectively study the subjective state of their subjects. They must understand that situations are complex, which demands a multi-dimensional approach in their search for meaning. Cox and Hassard (2005, p. 8) concurs with the above statements as he stated that the, "Qualitative research paradigm believes that the researcher is an important part of the process."

I was fully involved in the seeking of consent from the Provincial Department of Education and the collection of data using individual interviews and document analysis. I coded the data according to different themes, which will enable the reader to easily access the findings of my research study Glesne and Peshkin (1992) maintain that the role of the researcher is that of personal involvement and partiality. E. Henning et al., (2004) therefore agree that the instrument in a qualitative research is the „human kind". This demands freedom from bias on the part of the researcher and a skill on discovering the relevant meaning to the phenomena.

3.6 Sampling and site selection

Sampling is defined as the method of gathering some part of a group to represent the population, (Roberts, et al., 2008) & (Fogarty & Mugera, 2013). The sample was intentionally selected in order to meet the needs of the study and to answer the research questions. Such a type of sampling is referred to as a purposive sampling (Teddlie & Yu, 2007) stated that purposive sampling is commonly used in qualitative researchers where units are selected for different purposes. This is supported by Fogarty and Mugera (2013, p. 4) when she mentions that, "the researcher chooses subjects with a specific goal of focusing on particular characteristics of a population that are of interest, which will best enable him / her to answer the research questions." She stated that this type of sampling provides the researcher with justification to generalize from the studied sample. She further argues that there are a number of purposive sampling techniques each with its unique goals. Thus, a sample of this nature shares the same characteristics and has a broad understanding of the research topic.

A sample of 3 schools in Umlazi District in KwaZulu-Natal was selected. All these sampled schools fall under quintile five and are all located in well-established urban areas. They were purposively sampled as they consistently achieve a high performance in ANA tests specifically in Mathematics Grade 6. They were chosen because they are ex-model C schools and have learners and teachers of all races.

In these schools, only four educators were sampled as main participants for the study. These educators have been teaching Mathematics in Grade 6 during the time of ANA tests in the previous years. They were chosen because they are the ones who are continuously producing good results in ANA testing in Mathematics through their teaching strategies and were able to answer the research question of this study of determining the factors influencing the increasing performance in ANA tests at Grade 6 Mathematics.

3.7 Data collection methods

3.7.1 Document analysis

The data indicating learners‟ performance or scores was analysed. These scores were captured in a computerized mark sheet provided by the provincial examination office with all the names of learners who were doing Grade 6 Mathematics. The documents such as the annual assessment plan of the school, schedules of results and analysis, the remedial programme for the school, planning meeting with records of minutes, attendance register, physical and human resources within the school, monitoring instrument to ensure work is done were checked. Also under scrutiny were departmental and school policies, the school programme for teachers, assessment guidelines, the school testing programme, planning meetings and learner portfolios. These were all checked in order to establish the factors that contribute to their increased performance in ANA and lastly how the school managed the assessment programme of ANA.

Document analysis was chosen as a data-gathering tool because of the strengths that is possesses. Jensen (2000) stated that document analysis is a cheap method of collecting data as documents are available on site. He mentions that they provide crucial data on historical trends and allow ample time to study these trends when required. Despite its strengths, it had limitations like consuming much time and its authenticity cannot be guaranteed. The

documents were noted relevant for this study as they provided evidence on the performance of learners and the factors that contributed to such a performance. Mark sheets for ANA in Mathematics Grade 6 and the data in the provincial system regarding the sampled school were studied and analysed. Coombs (2007) mentions that analyzing documents sometimes discloses possible avenues for future research. After identifying a gap or a point of interest, the researcher can opt for more avenues in the topic in question.

3.7.2 Interviews

Interviews were conducted with the four teachers who had been teaching Grade 6 during ANA testing. Maree (2007, p. 87) defines "an interview as two-way conversation in which the interviewer asks the participants questions to collect data and to learn about ideas, beliefs, views, opinions and behaviours of the participants". These interviews were formal with well prepared questions and were conducted at a suitable time for each teacher without interfering with the teaching and learning periods. According to Gubrium and Holstein (2002, p. 85) "qualitative interviewing is a kind of guided conversation in which the researcher listens carefully in order to hear the meaning of what is being conveyed". This demands that the researcher must maintain a perspective of disciplined subjectivity Gubrium and Holstein (2002) must also possess questioning and listening skills. The mood of the interview was a relaxed one where the participants were free to contribute their opinion and comments.

The interviews were recorded on a digital voice recorder. This practice was done in order to ensure that information was preserved and utilized for data analysis purposes. As such, it was treated with strict confidentiality. Each interview took place at the selected schools, and it lasted 30 minutes. Merriam (1988) supported the use of tape recordings during interviews. A benefit of "conducting face-to-face interviews is that they enable the researcher to gain participants‟ cooperation by establishing a relationship with them, which facilitates the production of high rates" (van der Vyver, van der Westhuizen, & Meyer, 2014, p. 94).

In order to facilitate the meaningful progression of the interview, a prepared interview schedule was made. It contains a list of the questions asked. The strength of the interviewing technique in qualitative research is that there is a great interest in the participants‟ point of view. L. Cohen, Manion, and Morrison (2004) state that interviews provide inside

information, the interviewer can create new questions to fill the omissions as the researcher is always present when interviewing the participant and can give clarity if there is a need. It is also flexible or the researcher to make quick adjustments if need be. As Hardy and Bryman (2004, pp. 122-123) caution, "probes should be in the form of open ended questions so as not to influence the potential answers by limiting the options open to the participants". The major limitation of an interview is that it compromises privacy and anonymity of the interviewee. Before starting the interview, all the sampled educators signed consent forms to voluntarily take part in the study after I clarified their rights to this research study. As indicated above, interviews were conducted with four participants.

3.8 Ethical considerations

Creswell (2002, p. 13) maintains that „in order for a researcher to conduct research in an ethical manner, s/he must respect the rights of the participants, honour the research sites visited and report the research fully and with honesty". It is therefore crucial that a relationship of trust is developed between the researcher and the participants through observing the participants" privacy and by protecting their identity. That is why in this study the sampled schools and the participants were given pseudonyms to protect their actual identity. Bogdan and Biklen (2003) believe that a relationship of trust sets the mind of the participants at ease and they become more willing to speak honestly and openly. Gall et al., (1996) asserts that in order for the researcher to gain the interviewees" trust, s/he has to present a clear personal image to the participants. For example, the researcher may present herself / himself as a departmental official who is a teacher by profession and a researcher, that s/he has teaching experience and give details relating to his/her background in teaching and why s/he is a researcher.

L. Cohen and L. Manion (2000) maintain that ethical issues emerge from the different kinds of problems investigated by the researcher in order to get valid and reliable information. They further mention that problems may arise from the nature of the research study itself, the context for the research, procedures to be modified, the nature of the participants, data collection methods to be used and what is to be done with the data collected.

Gardner (2011, p. 5) argued that “ethics must be observed and individuals should be treated fairly, sensitively, with dignity and within an ethic of respect and freedom from prejudice regardless of age, gender, sexuality, race, ethnicity, class, nationality, cultural identity, partnership status, faith, disability, political belief or any other significant difference”. The researcher avoided all these discriminatory factors during data gathering.

The researcher also requested consent to conduct his research from the Provincial Head of Department for the school and participants concerned before the start of the study. Informed consent from all the participants was obtained in writing. Cohen and Manion (2000. p. 57) defined informed consent as “The procedures in which individuals choose whether to participate in an investigation after being informed of facts that would be likely to influence their decision.” They mentioned that the definition involves four elements: competence, voluntarism, full information and comprehension. As the ethical principle of informed consent and voluntary participation, participants were informed of their rights to withdraw from the study at any stage of the research. An ethical clearance certificate from the university ethics committee was granted to the researcher before the data gathering started.

As the researcher is a senior manager in Provincial Examination and Administration, he avoided any conflict of interest that could have arisen during data gathering like the way ANA tests were conducted in the sampled schools. The American Education Research Council (AERA) supports this when they argue that conflicts of interests arise when the researcher‟s professional, financial or personal interests have a negative impact in performing their work in an unbiased way.

Cohen, et al., (2000) maintains that is the obligation of the researcher to protect the anonymity of the research participants and maintain the confidentiality of the research data. Plagiarism was avoided in this study as researchers‟ or other authors‟ work, findings were referenced, and direct quotations were indicated by direct quotation marks.

3.8.1 Trustworthiness

Leydens, Moskal, and Pavelich (2004, p. 66) describe it as "how we determine whether we have accurately described the settings and events, participants‟ perspective information." The standards of Guba and Lincoln (1994) were adopted in this study for evaluating qualitative enquiry so that data was correctly collected and presented. Hardy and Bryman (2004, p. 273) also believed that "trustworthiness is made up of the four criteria / standards by Lincoln and Guba". The three main criteria are trustworthiness, credibility and conformability used in this study.

3.8.2 Credibility

Hardy and Bryman (2004, p. 30) stated that "credibility is defined as how believable the findings area". This is supported by Maree (2007) when he mentions that the researcher must give out results or findings that are believable and convincing. Brief notes were taken during interviews to assist in interpreting the data correctly. On the other hand, audio tapes were used to record the conversation of the participants during interviews, which in turn assisted in maintaining the authenticity of the data.

3.8.3 Conformability

Casey and Murphy (2009) stated that the research findings should replicate the participants and the research problem. They mentioned that the findings of the study could be confirmed by another study. This demands that the researcher findings must not emanate from the bias and prejudices of the researcher. In this study, I was fully aware that my position as a departmental official might influence my interpretation and possibly distort my perceptions of the participants. The researchers was therefore always in touch with the research topic, aims and questions in order to ensure conformability. Miles and Huberman (1984) stated that the researcher must adopt the principle of neutrality regarding the phenomenon in question.

3.9 Conclusion

A qualitative approach, which falls under the interpretative paradigm, was used. The constructivist case study was discussed followed by the role of the researcher, specifically the qualitative researcher. Sampling and site selection were clearly stated. Two data gathering methods were used in the study, that is, interviews and document analysis followed by trustworthiness and ethical consideration. The next chapter will deal with the analysis and interpretation of data gathered from the teachers of the sampled schools

CHAPTER 4

INTERPRETATION AND FINDING OF THE INVESTIGATION

4.1 Introduction

In the previous chapter, I presented a detailed account of how the data was produced for the study. In this chapter, I present the data within a thematic approach to data organization and presentation for analysis leading to key findings of the study. The research was aimed at establishing the factors that contribute to the increased performance in Mathematics at Grade 6 as determined by the ANA testing by exploring what happens in schools that have shown a consistent improvement in performance during the last three years. The data was largely produced through interviews with teachers from three public schools ranked as quintile 5 schools. Quintile rankings are based on poverty and infrastructural criteria, with quintile 1 schools being the poorest of school types and quintile 5 schools considered to be wealthy. The selected schools were chosen from quintile 5 rankings and this was done to minimize additional influencing factors, noting that socio-economic factors cannot be ignored in school education.

An analytical framework was developed to assist with the management of the data, the element of which forms the three themes within which the data is presented and analysed. The chapter commences with a description of the schools, the teachers and ANA results for Grade 6 Mathematics, followed by an explanation of the analytical framework that guided the data analysis process. Data presentation and analysis follows within the three identified themes. The chapter then concludes with a discussion of findings located within a theoretical gaze of the school situation.

4.2 Selection of sample schools biographies

Three schools were selected from one school district. The selection process involved obtaining ANA results for Grade 6 Mathematics through the Umlazi District office and identifying schools that have shown an increasing learner performance in ANA Grade 6 Mathematics over a three year period (see table 4.1). From the list of identified schools, only quintile five schools were targeted for possible inclusion in the case study schools. The first three of those potential schools who agreed to participate in the research process became the

sample schools for the study. Teachers teaching Grade 6 Mathematics in these schools were identified as participants for the interview process. Each of the schools is described below. The schools are labelled as school 1, school 2 and school 3.

Table 4.1 Grade 6 Mathematics performance in Annual National Assessment for the period 2012 to 2014

SCHOOL	2012	2013	2014
School 1	74.08%	80.45%	82.79%
School 2	59.61%	73.85%	80.72%
School 3	59.63%	72.89%	80.03%

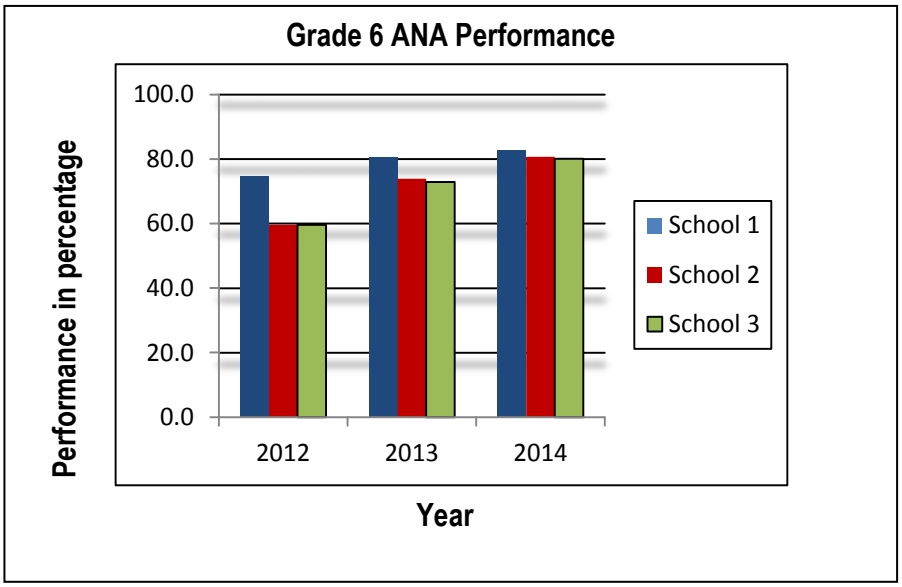

Fig 4.2 Graph of ANA performance in Grade 6 for the past three years

4.2.1 Biography of sampled schools and descriptions of teachers

School 1: This is an enormous school that was built in 1967 for white learners situated in the suburbs of the city of Durban. Currently the school enrolls girls and boys from grade R to 7. There are children from all races enrolled in the schools. The school is neatly fenced with wire and has two entrance points with a security guard at each gate. One has to state his or her business before entering the school. There is a book where personal information is filled in. The gate is remotely opened and visitors are directed to parking spaces. The cars within the school premises range from Mercedes to a Toyota. There are several rows of classrooms alongside each other. The majority of teachers in the school are English speaking and the medium of instruction is English.

The school has several offices. The secretary‟s office has a computer; fax machine, a photocopying machine and a telephone, and has ceramic tiles on the floor. Next to it is another office for information pertaining to the school history with a selection of books. The next office is the principal‟s office, which is very neat with a big wooden table and a leather chair and laptop that are connected to a telefax with a printer. The principal‟s office has large windows with a bathroom towards the left of the office. The books and files are neatly packed in a cabinet. Adjacent to the principal‟s office is another office where visitors sit when they come to the school. There are sofas and a small coffee table on which are a variety of magazines on sports, health and general information. There is an urn with hot water boiling and a tray of cakes and muffins on the side. A staffroom with several big tables, a large double aluminum door leading into it is adjacent to the administrative offices.

Adjacent to the staffroom there is a passage leading to the deputy principal and heads of department‟s offices. A little further there are toilets for the staff. Along the passage, there are attractive medals and trophies. At the end of the passage there is a large door leading to the classrooms. The school has a huge hall with glass panels that serve as the walls. Opposite the administration block is a swimming pool that has six lanes. At the far end of the swimming pool there are two rugby fields and a hockey field with a netball field opposite to the hockey field. The grass is cut short and neatly kept. The learners are dressed in their khaki shorts and white shirts for boys and a green dress for girls who wear brown sun hats. There is a clear display of respect and discipline by learners in the school.

In School 1, there were two teachers interviewed and they are referred to as teacher A and B. Teacher A and B were interviewed during the site visit at school. Both teachers were qualified Mathematics teachers and had 32 years of combined experience in teaching Mathematics at a primary school. Teacher A was currently doing a master‟s degree in education at the University of KwaZulu-Natal. Teacher B was the mentor for all new teachers who arrive at the school.

The school is well structured in terms of reporting and accountability structures. The teachers describe the school as being well organized, staffs works as a team and they take their schoolwork and teaching of learners very seriously.

School 2: The school was built in 1959 and is situated next to a hospital and opposite the racecourse. The school caters for both girls and boys and enrolls from grade R to 12. It is situated opposite a busy road and is a three-story building. The learners are neatly dressed in their white dresses for girls and grey pants with white shirts for boys. The school enrolls 1345 learners with a staff complement of 65 teachers. It is important to note that some of the teachers who are employed at the school by the school governing body are paid a salary through the schools fees. The learners are dropped off by their parents in expensive cars such as Mercedes, BMW‟s and Audis‟. The main office has a reception area with a large chandelier light hanging from the ceiling and the area is well air-conditioned. The palisade is used as retaining walls. Construction is taking place opposite the reception area.

There are two women working in the reception area where there are two large plaques on either side of the walls with learners‟ names who have performed exceptionally well throughout the years. The access to and out of reception is controlled using an electronic scanning system for staff members who each have a disc. The main entrance and the assembly area of the school is fully tarred with trees planted along the palisade fence. The medium of instruction is English. In terms of the matric results, the school consistently gets 100% and had, for several years, produced learners in the top 10 category for high achievers provincially. Opposite the reception, area is a two-story block which is specifically built for administration and other offices situated in that area for staff members. There is a Chief Executive Officer (CEO) at the school who ensures that the school is well managed. There

are two principals at the school, one for primary school and another principal for the high school. They both have personal assistants to manage their office.

Adjacent to the staffroom there is a passage leading to the offices of the deputy principal and the heads of department, beyond which there are toilets for the staff. The administration block is fully tiles with ceramic tiles. The school has 5 secretaries who handle the school administration. There is a central point for printing of documents for the school. The learners are very respectful and wear their uniform and a school badge. The school is fully resourced in terms of teaching and learning material and there is a media center, library and a computer room. The school is well maintained, neat and has a good infrastructure. The school participates in soccer and cricket.

In school 2 one teacher was interviewed and is referred to as teacher C. Teacher C was qualified in Mathematics and had taught in different schools throughout the province.

The management of the school is excellent, the structure is clear, and everyone knows their roles and responsibilities, starting from the CEO. The school is run professionally, rather like a business.

School 3: This school opened its doors for the first time in 1958. At that time, there were only 102 learners. Since then the enrolment had increased to 623 in 2014. The school caters for Grade 4 to 7 learners constituted of boys and girls. The school is situated with magnificent views of the ocean. The school has four classes per grade with a class size ranging from 26 to 28 learners. The academic staff consists of 32 teachers and the support staff is 15. The infrastructure is well maintained with palm trees planted near the main office. The classrooms are bright and breezy with many windows and sliding doors.

The classrooms are equipped with white boards, a computer, data projector and a cable internet link. Each class has its own email address. The school is an eco-school and has received an award for eco-school flag in 2008 and an international green flag in 2011. There is a well-equipped computer center and learners have access to the internet and numerous English and Mathematics programmes including Cami Mathematics. There are two smart boards, one in the computer room and the other in the media centre, which are interactive and

linked to a data projector and computer. There are media for learners to use to search for information from the internet linked computers for their projects or assignments. The media centre is well resourced with a wide range of fiction and non-fiction books. The school has a swimming pool and two large fields. The school participates in the following sport codes: cricket, netball, rugby, swimming, hockey, tennis and soccer for boys and girls.

In school 3 one teacher was interviewed and will be referred to as teacher D. Teacher D was qualified in teaching Mathematics. She was middle-aged and had previously taught at a high school out of the province of KwaZulu-Natal. She was capable and able to teach Mathematics up to Grade 12. Teacher D had 23 years of experience teaching Mathematics at primary school level. She also taught Mathematics in Grade 9 level at this school.

4.3 Analysis process

Schumacher and McMillan (2006, p. 364) mentioned that the data produced from his study through the interviews and documents analysis was "manually analyses by transcribing, segmenting, coding, categorizing and forming patterns to allow plausible explanations." Similar topics were grouped together in the interviews. The data was matched to establish themes and emerging patterns. Emerging themes and patterns were recognized, written down and refined once all the data had been reviewed. The refinement process included cross-referencing the themes with the research question to ensure that the investigation remained on trajectory. The themes were related to the teachers, learners and school. While these themes are broad and all-encompassing, the upward trajectory of learner performance in ANA Mathematics from each of these perspectives tells a different story. The early identification of the themes and story line allowed me to organize and manage the data coherently. Fig. 4.3 captures a diagrammatic representation of the analytical framework developed for the management and organization of the data and shows the story lines within each of the themes.

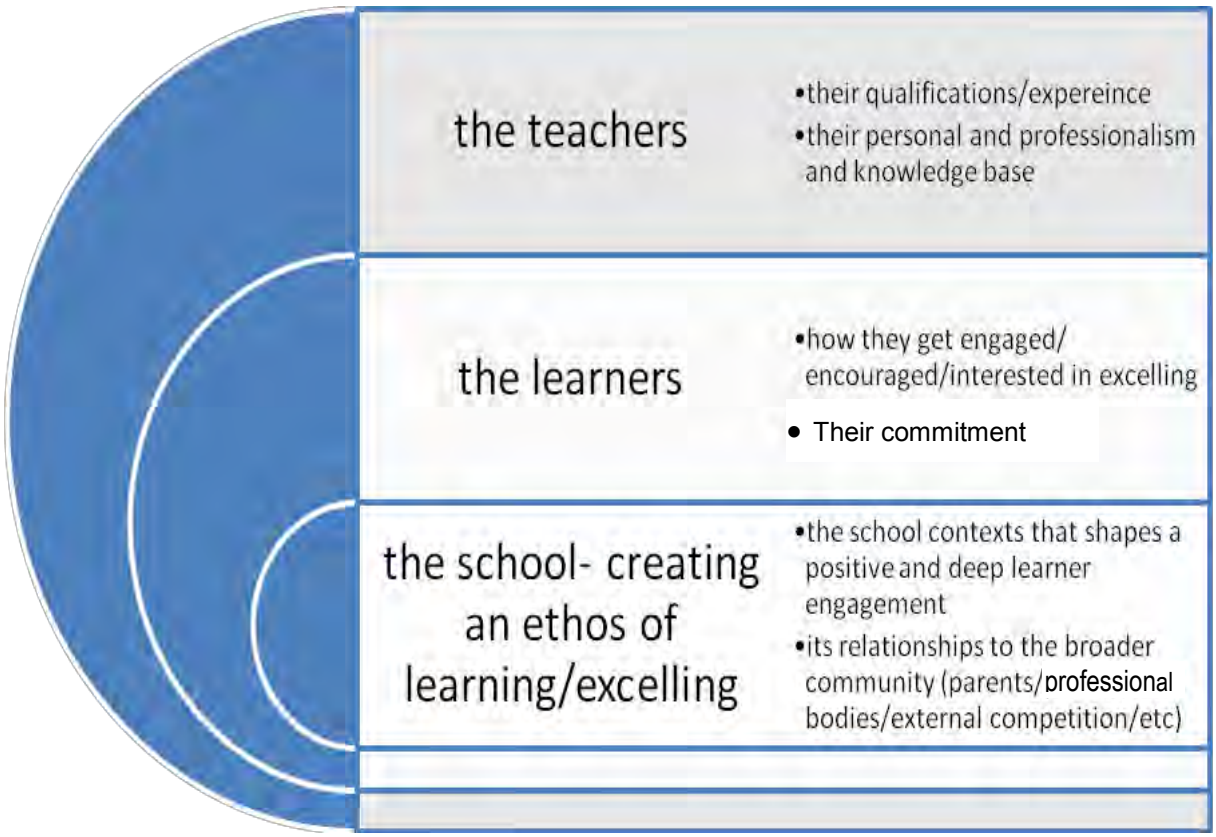

Fig. 4.3: Analytical framework developed for organising and managing the data

The analytical framework could also be reflected as a funnel (see Fig 4.4) where the interrelationship between the teachers, the learners and the schooling context. These are within the funnel that leads to an explanation for the improving learner performance in ANA Grade 6 Mathematics which is the nozzle of the funnel. This nozzle component of the funnel frames the explanation of the findings through an overall theoretical lens of Bronfenbrenner‟s ecological theory as adapted for this study.

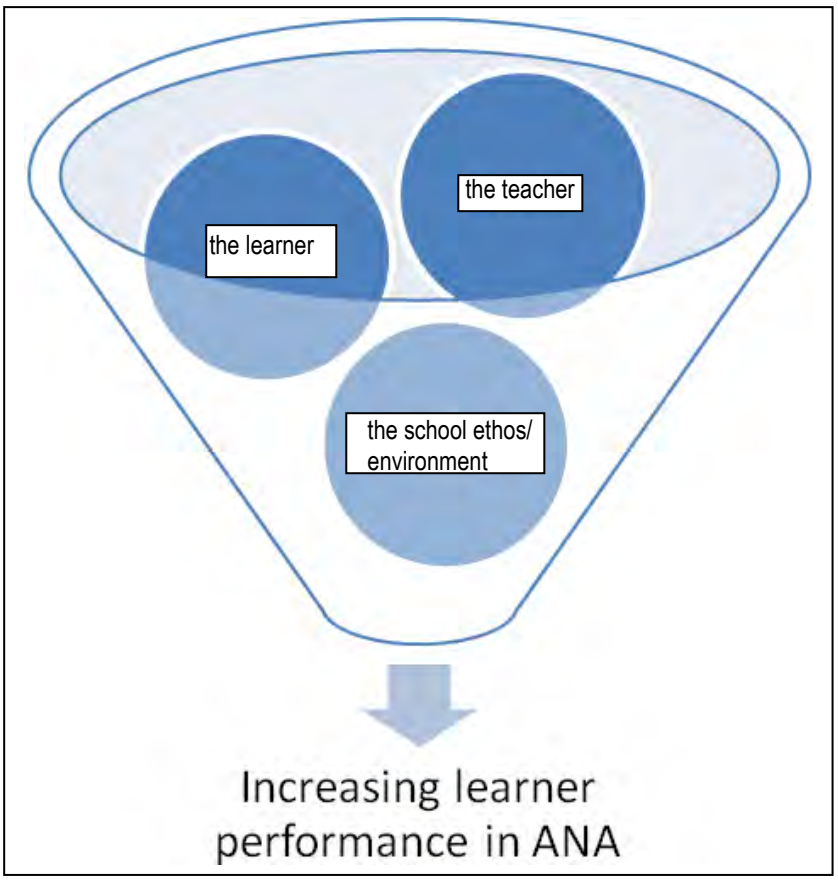

Fig 4.4: Alternative representation of the analytic framework

4.4 Research Findings

The findings of the research study based on the main categories that emerged from the data that was collected during the interviews, observation and document analysis are organized and discussed under three themes. Within each of the themes, further sub-themes were developed to capture the essence and key findings of the study.

4.5 Theme 1: The role of the teacher in promoting learner achievement

This theme focused on the qualities of the teacher which were considered as factors that contributed to the increasing performance of learners in the ANA Grade 6 Mathematics. The qualities included the capabilities, their interests and their drive to excel. Each of these qualities is discussed under sub-themes.

4.5.1 Capabilities of teachers in promoting learner achievement

The content knowledge and content pedagogical knowledge, according to Nagle and Sanders (1986), are among the basic professional knowledge that all teachers should have. There are a number of factors that might influence the teaching of mathematics at school level but teachers play a very crucial role. Turnuklu and Yesildere (2007) believed that common belief in every society is that a teacher who is best at teaching Mathematics is the one who knows Mathematics very well. Fennema, Carpenter, Franke, and Carey (1992) stated that knowledge of content, knowledge of Mathematics which is the content knowledge that look at the nature of Mathematics teachers‟ knowledge is important to teaching. They believed if a teacher has a conceptual understanding of Mathematics, s/he positively influences the classroom instruction.

Shulman (1986a) mentions that teachers have to master two kinds of knowledge in the teaching process, that is knowledge of the curricular development and the content or the knowledge of subject. She formed a model of Pedagogical Reasoning, which consisted of a cycle of several activities to be completed by a teacher for good teaching; comprehension, transformation, instruction, evaluation, reflection and new comprehension. She stated that teachers need to have an understanding of what they teach using various strategies. She is of the notion that the comprehended ideas must be transformed in a particular way in teaching and required a combination of preparation, representation, adaption and tailoring the adaptation.

The teacher must instill valuable conceptual knowledge in children in order that they can consequently solve problems that they may encounter. M. Henning and Vinoski (1999) mentioned that problem solving depends on the conceptual knowledge and procedural knowledge that the child possesses. The children without knowledge of the subject matter have trouble in solving problems.

From the biographies of the teachers, all of them were qualified in their field of teaching Mathematics at the General Education Training band (GET). They had either studied at a university or at a college or obtained their qualification in terms of a teaching degree or diploma. Their teaching qualifications developed in them their Mathematics content

knowledge as well as their pedagogical content knowledge to prepare them for teaching of Mathematics at the primary school level. Some of the teachers had sufficient Mathematic content knowledge that allowed them to teach up to Grade 12 Mathematics. Hence, one of the contributing factors was that all of these teachers were appropriately qualified to teach Mathematics at the Grade 6 level. One of the concerns raised by Spaull (2013a) in response to the dismal performance of South African learners is the quality of teachers in terms of the specialization competence. He (Spaull) argued that the low learner performance in grade 6 ANA mathematics was related to teachers not knowing their subject content, an argument supported by Bansilal, Brijlall, and Mkhwanazi (2014)where they found that less than 30% of the sampled Mathematics teachers were able to pass the examination set for their learners. The finding through this study suggests that appropriately qualified teachers are an important consideration in learner performance. The increasing trend in learner performance noted across the sampled schools bears testimony to this assertion.

It must also be noted that the schooling system does have appropriately qualified teachers teaching subjects that they are qualified to teach, but the link to improved learner performance in not clearly linked to their capabilities. This means that other factors are also crucial in promoting an upward trend in learner performance. Hence, it is not axiomatic that well qualified teachers will produce good results in learners. The complexities of the schooling system are important considerations and the funnel representation of the analytical framework alludes to this complexity.

The teaching experience is another factor that contributes to learner improvement. In this study, the teaching experience of teaching Mathematics at Grade 6 ranged from 6 years to 23 years. The crucial aspect of teaching experience is related to two aspects. The first relates to experiences of teaching the same subject over a number of years and the second relates to teaching mathematics in the same school over a number of years. In both these aspects, the sameness is the crucial factor within the experience discourse.

> **Teacher A says:** *I do enjoy teaching mathematics at the school, because of the manner in which it is structured and for the approach that the school has adopted but to be honest at the other school I did not enjoy because of the prescriptive way that*

was imposed on all the teachers. Teaching mathematics allows me to ensure that the knowledge and experience I have gathered throughout years helps the children.

Teacher C says: *I also have taught Drama and taught everything except for Zulu because I do not know or have the knowledge. Nevertheless, out of all the subjects I have taught mathematics is still the best subject I know because of the knowledge and experience I have accumulated over the past years.*

Teacher D says: *The reason I have no problem is over the years I built sound content knowledge and I use it now when I teach Mathematics.*

Two things emerge from these statements by teachers A, C and D. Firstly there is the sameness of teaching Mathematics suggesting that being in one environment and teaching Mathematics over the years have contributed to the teachers‟ maturity, knowledge and understanding of the teaching ethos of the school and in line with the expectation of the nature of learners that attend that school. The second relates to the opportunities that teaches have in that school. They operated in a professional environment that allowed them the flexibility to engage with the learners and the course content, rather than being in a prescriptive environment that restricted the teachers‟ autonomy. Hence, stability of teaching of a subject does matter in learner performance.

The nature of the teacher does contribute to the increasing performance of learners because they are sufficiently qualified to deal with the content matter of Mathematics at Grade 6 level. There was a clear passion of teaching and commitment from all the participants interviewed as they took a keen interest in their work.

The participants interviewed showed total professionalism in terms of the way they have carried themselves in the teaching profession. They have kept to the principle of educating the learner. This became evident through the interviews conducted when teacher C in school 2 mentioned to what extent they go in order to educate the learner as a whole, for example *“As a teacher I set up extra class lessons for learners who are struggling to grasp the concept of Mathematics in certain lessons. I ensure I take ten learners at a time and arrange*

classes in the afternoon from 3pm to 4pm. I do this to I get to understand my learners better and provide a close support programme for them at the school." In school 3 for example she said, *"We pair our learners in different groups and allow them to work together with their peers and as a teacher we just facilitate the working together of the learners."*

The professionalism in these teachers is also key to the success of the learners. Their professional ethics have been noted through the care that they take in ensuring that the students are learning. The additional classes, small groups and by ensuring that the learners understand key Mathematics concepts are examples of the professional ethics that these teachers display. Hence the interviews participants related to teacher professionalism "at work" (meaning the explicitness of their professional ethics in teaching) is also a key driver for improved learner performance. Teaching methodologies also seem to be key to improving learner performance. Their ability to strategise and use appropriate teaching methodologies at appropriate times and with appropriately linked learners/learner groups is also linked to teacher professionalism. They are able to select appropriate teaching and learning strategies commensurate with the learner needs. What this points to is that these teachers have a personal understanding of their role as a professional teacher and therefore act in such ways that they use and account for their professionalism.

Of concern though, is their teaching to assessment, suggesting that assessment is a crucial driver informing their teaching practices. The learners are consistently exposed to various types of assessment. They also mentioned that the learners are exposed to different kinds of external assessment in order to establish how the school is performing. A teacher in school B had the following to say, *"We do external evaluation in order to be assessed outside of our comfort zone and to see how well we are performing and our children have ensured that we do well in the regional and national Mathematics competition. As a school in the past five years we obtained position one and that means we are doing something good and it's working for the school and our children".*

Broadhead (2006) states that assessment is an integral part of the learning process and has both formative and summative functions. When the assessment question was posed to the schools, very interesting information came out, for example, teacher A in school 1 said that: *"Obviously when you are assessing them all through what they can do or what they cannot*

do and the test should be used as a diagnostic tool so that you can look at what you still need to do. That is why we are opposed to "CAPS" not necessary what is stated in the document but the point is that it"s one size fits all, it"s not true about education because every single class is different and every single year is different and your class leads you or takes you where you got to go." The use of formative and summative assessment was emphasized.

They further explained that: *"They assess all the times we do a lot of problem solving and all the times they are introduced to different aspects of Mathematics." "Assessment takes different forms to us and there is continuous assessment and that is daily, so every time a child stands up to give a strategy I can assess, this time they felt more confident given actually more thought I can see that in children that are stronger at Mathematics you working with accuracy and precision, we also conduct formal assessment, that we do on an on-going basis at the end of every concept so if teaching, for example, a concept multiplication should be taught as a vertical algorithm, then there is a formal assessment at the end of that section to see if they are able to do a vertical algorithm for multiplication or not. Another form of assessment all our external competitions, internal assessment and national assessment through ANA we are taking part in every single Mathematics competition that we have access to. We getting outside verification that what we doing is working and sound and it can be transferred."*

The assessment in school 2 and 3 takes the shape of CAPS and the teachers agreed that they use continuous assessment but policy also dictates that there be formal assessment and these are conducted twice a term. Informal assessment is always used during lessons and homework is given to assess how well they understand new concepts. It is use in terms of reinforcing Mathematics taught in the classroom. With Mathematics, we assess every day and the learners seem to enjoy the morning session when we allow them to use the white board to write the answer and show how they solved the problems.

A further consideration related to teacher professionalism is communication and understanding between teachers and learners. Hill and Lubienski (2007) remark that one type of intellectual work that a Mathematics teacher performs is to make abstract mathematical knowledge understandable in everyday language. In attempting to do this, teacher A from school 1 mentioned the crucial role that language plays in the understanding of Mathematics.

This is also one of the reasons why some schools underperform .Teachers do much code switching from language of teaching and learning to home language of certain learners. Teacher A describes that importance of understanding Mathematics in the following way: *"You got to understand that these learners come from a very good foundation phase, where everything to begin with, new concepts are taught through real life problems and children are taught to think for themselves and they are taught to read using sacker linguistic approach which is reading for meaning and understanding so right at the beginning they are exposed to vocabulary, exposed to patterns and they talk about Mathematics."*

Making Mathematics real for learners plays an important part in learners‟ performance in Mathematics. Mathematics teachers, based on their mathematical knowledge and experience in teaching Mathematics, should be able to identify Mathematics in everyday life if they are to pursue a learner centered, constructivist approach of bringing new knowledge into the world perspective of the learner. Teachers in the selected schools have indicated that they consciously make Mathematics relevant to the learners by relating Mathematics to their reality. For example, teacher A says: *"My major role is to identify the problems and to find the opportunity to use Mathematics."*

> **Teacher D says:** *"We also use real life objects, concrete objects surroundings and try to make Mathematics real for the learners. I think my method is still teacher centered because I always do a couple of examples from the texts book and then try to link with other concepts".*

Drawing from the above engagement of the role of the Mathematics teacher in influencing learner performance in Mathematics, it is clear that teachers need to be well and appropriately qualified in the teaching specialization. This qualification is, however, not sufficient to promote effective teaching and learning. The capabilities of teachers beyond just their qualification is crucial to connect with learners and create a conducive learning environment is equally important. Their professionalism, their ethics of care, their communication with learners and their ability to bring Mathematics into the lives of learners are necessary to promote an ecological perspective Bronfenbrenner (1994) of influence on learner performance.

Hurrell (2013) asserts that the quality of teaching is one of the contributory factors of determining mathematical achievement. This demands that the educator must possess professional knowledge in the content of the subject. Shulman (1986b) identified seven categories of professional knowledge that are required in teaching Mathematics. They are content knowledge, general pedagogical knowledge, curricular knowledge, and knowledge of the learners, which includes their development, cognition, motivation and characteristics, knowledge of educational contexts, knowledge of educational aims, pedagogical content knowledge, goals and purposes. Additionally Hill et al., (2005) investigated mathematical classroom activities to discover the challenge encountered by teachers in linking their subject matter knowledge with their pedagogical content knowledge that is necessary. They determined that teachers should have both the subject matter and the pedagogical knowledge since teaching of Mathematics comprises of different situations, which require teachers to have exhaustive knowledge of Mathematics and the skill to use that knowledge in different circumstances.

4.6 Theme 2: The School governance, infrastructure and ethos as they relate to learner performance

The infrastructure of all three schools is excellent. This can be seen as you enter the school premises. The buildings of the schools range from three stories to a sing story. The schools are fully fenced with clear directions where learners enter the school and where parents drop off their children in the morning and pick them up in the afternoons. There is security personnel at each gate and there is security that also controls the flow of traffic at these schools in the morning and afternoon. The infrastructure is set up in such a manner that it is conducive for teaching and learning to take place.

The teachers arrive early at the schools and classes starts on time at 7:40 am at schools 1 and 3 whereas at school 2 commences at 7:30 am. The schools are well constructed and the teachers and support staff comes to school fully prepared to work. This is evident in the sense that classrooms and offices are opened much earlier than the time of teaching and learning.

The school management is set from a strategic point whereby school 1 and 3 are totally controlled by the principal who is appointed by the Department of Education, whereas in school 2 there is a CEO and there are two principals, one for the primary school and the other for the high school. They have a full complement of staff and others are employed by the school governing body to provide additional support to the learners at the school. All school management operates through distinct lines of communication and they understand their duties within the school. The management is responsible for providing and overseeing the quality of education that is provided by the schools and the assessment that takes place.

The school leadership is available at all three schools to provide strategic leadership and ensure that the school complies in terms of school policies and departmental policies. The leadership provides support at the school and ensures that the school is managed in an effective and efficient way. The leadership ensures that all staff signs in. Wedekind (2010) states the strong leadership is crucial to school efficiency that is eventually reflected in the learners‟ performances. The teachers are aware of the lines of communication and know how to use them. The relationship between leadership and staff is cordial. The roles and responsibilities are clearly spelt out in the school policy and each teacher has one because they sign for them at the beginning of each year and are reminded of them. There is complete order in these because teachers, learners and other stakeholders understand how they should be operating within school premises at all times.

The organisation of the school is such that learners come to school in full school uniform and there are no exceptions. There are subjects or learning area teachers who are responsible for the delivery and assessment of the curriculum for the learners. Their immediate supervisors who are Heads of Department manage the teachers. The schools have a year planner and timetable to ensure that activities within the school run smoothly and properly. During an interview teacher D mentioned the following: "*The head of department makes arrangements with all teachers under their supervision to do regular class visits to assess what is actually going on in the classroom during the lessons and establish if effective teaching and learning take place in the classrooms."*

The lessons are prepared daily and have to be checked by the Heads of Department prior to teachers using them. The lessons are submitted for moderation and any support material to be used is checked so that it does not infringe on the rights of learners and does not put the school into trouble with the community and the department of education. The school has a clear monitoring plan of lessons and work being conducted in the classrooms. The Head of Department as part of his/her roles and responsibilities, is the assessor of what actually goes on in the classrooms, for example they check on the work of learners. For example Teacher D in school 3 said the following: *"We as teachers have to submit our daily preparations, which are work schedules and learning programme to the Head of Department and if there is a problem they are called into the office to correct that issue. If it further persists the matter is handed over to the Deputy Principal to resolve. The Head of Department also provide guidance on the subject or learning area."* From the above account, it seems quite clear that a school with good organisation and excellent management tends to function well as a school system. Fullan (2009, p. 45) states that, "No improving school that doesn"t have a principal who is good at leading, improves." It is evident that school organisation, rules of engagement, collaboration, and co-operation are key to a sound schooling system. Developing and maintaining such an ethos in each of the participating schools seems to contribute to the increasing learner performance.

The schools that participated in the research were situated in quintile 5. The increasing performance had no relevance to the school being in quintile 5 or the school being old or new. It was identified that there is a combination of factors within the school that is able to bring all these kinds of factors together.

The schools adopted a common approach to teaching and learning, which is the constructivist, learner centered pedagogy. The implications of this is that it is complementary because all teachers have adopted this ethos and collaboration, peer support and learner expectations from teachers, which all contribute to positive development, leading to better learner performance.

> **Teacher B says:** *"We are both teaching grade 6 children and using the constructivist approach in our work because we work together in everything we do."*

The participant in school 1 mentioned that the approach to teaching and learning is guided by the constructivist approach, which was introduced to them a while back. The participant in this school 1 is teacher A who pointed out, *"When we were still separate Departments of Education, way back the Natal Department of Education introduced the constructivist approach to Mathematics and it was started by Mr. Jones and Mrs. Green (pseudonym). They piloted it in the Western Cape and then introduced it in KwaZulu-Natal. It was then piloted in some of the schools and we adopted it here and when the departments of education merged we and other schools kept the constructivists approach. However, we are also aware that some of the other schools dropped it. Possibly we are still one of the last schools that have carried on with it because we believed in it and the child internalizes that knowledge and teaching for understanding and it"sbeen successful and it is a lot of hard work."* When a follow-up question was posed to teachers A and B they continued to mention that, *"We do use learner centered, problem centered and constructivists approach and also socio-sharing of ideas and discussions. It"s not sectionalized, but it"sintegrated and the whole thing is to make patterns and recognize connections between mathematics concepts."*

The learner-centered approach was also confirmed by the two other schools that is school 2 and 3. The teacher in school 2 commented by saying: *"I become a facilitator during some of the Mathematics lessons and the children interact amongst themselves."*

In school 3 teacher D alluded to the issue of a learner centered approach in this manner: *"We have white boards where learners go up to the front and demonstrate to other learners how they managed to solve the Mathematics problem and provide a clear point of step-by-step analysis and explain to their peers. During this time of we step aside and allow for active discussion amongst the learners."*

It is evident from the above quotations that learner centered and constructivist approaches are used during the engagement with learners in the Mathematics classroom. The learners are actively allowed to engage in the lessons and this builds self-confidence in learners.

Participant Teacher C says. *"Right at the beginning they are taught about numbers and come to understand that oneness of one and the twoness of two because they are working with manipulative. They are working in groups. They working through problems and the teacher*

*don"tsay this is how you subtract. It is a problem situation and eventually they learn to write the Mathematics this is how it be written and up here they have a lot of experience with that and lot of confidence working in a risk-free environment, where most learners feel free and confident in what they are doing.. Their tables as well as bonds and tables are not taught rote fashion. It"s what do I know and what can I do, for example with the 7 times table, they know they have doubled and halved and they will multiple 2*7 and 4*7 is double that. They will work on a page and these are the things I know and this they will be able to fill in the other factors that they know. It"s allfrom a point of understanding."*

Participant Teacher D says. *"Previously, when I taught Mathematics, it felt „traditional"I felt that I was driving the lesson and that I was doing most of the speaking and that I was actually giving the children, what they don"t have to fill their minds. In this constructivist approach I feel that I"mfacilitating the process, I play a very valuable part and I have to say my colleague develops the lessons and my major role is to identify the problem and to find the opportunity to use the Mathematics. Once I have given them the work for the day or posed the problem, they run with it (children), they are in charge, they are in the driving seat, they originating the answers and even in terms of what comes out at the end."*

The learners in all three participating schools had come through the grades of the school, meaning that they started their schooling in grade 0 and remained in their respective schools. This is an important consideration in terms of the learners growing into the ethos of the school and of building up from initial grades to higher grades with teachers knowing what was done in previous years. The constructivist approach to teaching and learning has been part of the school ethos and frames what the teachers do and how the learners learn.

Part of the school ethos is also about how the school profiles itself on learner achievements and learner performance. In one school, aspirations of the learners are encouraged through recognition of outstanding performance. While this recognition is expected across all schools, the consistency of high achieving learners and the recognition thereof is the crucial point. In school 2 teacher B, the consistency of learners performing well, which is nationally recognized, is what provides the aspirational trajectory for learners in that school.

In school 2, the learners‟ performance is always high and teacher 3 mentioned the following, *“At this school we always get learners that perform very well at the National Senior Certificate (NSC) which is matric ever year. We have learners who are in the top 10 of the KwaZulu-Natal province always and they are some of them are in the top 10 national of the country of South Africa. Our learners are high achievers and this evident also at the reception area of the school, where there is a list of all top achievers throughout the years.”*

To confirm this statement I did check the results of school 2 at matriculation level and they do have an outstanding record in terms of their Grade 12 results. This benchmarking of learner performance is one such example of the influence of the school ethos on learners. Learners become aspirational quite early and this aspirational trajectory is encouraged by the school through its recognition and acknowledgement systems and supported by parents who want to see their child excelling.

Mathematics, as a subject, has always attracted a special interest amongst learners, teachers, schools, the Departments of Basic and Higher Education and beyond. Learners fear Mathematics and teachers are generally concerned about the poor performance of learners in Mathematics. The potential of Mathematics in future development both in the learners as well as in the world of work or academia. This school subject does something to learners, teachers and other stakeholders. In the participating schools, Mathematics as a school subject is not made out to be feared.

> **Teacher A says:** *“The interesting thing for me is that Mathematics does not have a stigma here. There is not a huge emphasis on Mathematics. It is a part of the whole day. It is a part of their learning. They don‟t define themselves as I “hate Mathematics”, “I cannot do Mathematics” or “I love Mathematics” and “I‟m very good at Mathematics”. Here everybody does Mathematics and everybody gives it their best shot.”*

> **Teacher C says:** *“The manner in which each sum is approached helps determine their attitude. They are always willing to try to do the sums.”*

Teacher C says: *"I remember asking what is difficult about Mathematics and they replied: Mam we do not understand. We do a lot of Mathematics. The starting point is abstract to concrete, and they see it coming together. We have additional resources to support our learners for their interaction."*

Mathematics, therefore, as a school subject is not made to appear special by learners and teachers, suggesting that all subjects are considered as relevant, important and doable. This is an important aspect of a school ethos. Each learning moment through each subject is considered important and has similar relevance to the overall school learning by learners.

4.7 Concluding comment on school ethos

Under this theme, it was fond that the nature of schooling is an important consideration in learner performance. Having a school that is well organized, with appropriate resources and adequate staffing, is an important element in an effective school that promotes teaching and learning with a view to improving learner performance. Equally, the character of the school is a crucial driving force in creating as aspirational context for learners to excel and be recognized for excelling. The continuity of learner achievements and recognition contribute to the potential of all learners to excel and be rewarded. Finally, but no conclusively, how learners are made to feel about the subjects that they take contributes to how they perceive that subject and how they perform in that subject. Having a school ethos of equal recognition of the school subject and the ability of all learners to take and perform well in all school subjects provides a conducive school environment to promote learner performance. Yet it is also known that such a school ethos may not necessarily lead to good leaner performance. The ecology of the school and of learner performance is also dependent upon the learners and this factor is explored in the next theme.

4.8 Theme 3: Learners and their role in learner performance

Having good teachers, a well-resourced school and a good school ethos is not enough to ensure a good learner performance. Learners are also a key aspect in the teaching-learning context related to learner performance. The attributes of learners and their support structure are considered in this theme.

4.8.1 Role of parent.

Parental participation in the school education of their children has been noted to be a crucial component (Henderson & Mapp, 2002). However, the nature of parental involvement is even more crucial, as this study reveals. The parents embrace a philosophy of partnership with the teachers and school. The parents stay in touch with the child‟s teacher and share their expectations and academic achievement. Parental involvement ranges from supervision of homework to deep school involvement beyond just their children‟s school education. It has also been noted that many parent, especially from lower economic grouping, do not get involved in their child‟s school education, the reasons ranging from not living with their children during their schooling to disinterest in their child‟s school education. Some parents claim that their demanding work schedules prevent them from getting involved with their child‟s school education, some claim a lack of know-how and resources, whilst some frustrated by school bureaucracy. Lastly, some parents complain that they rarely hear from the school unless there is a problem with their child‟s behaviour, school fees, uniform or performance (Henderson & Mapp, 2002).

From the data gathered during the interviews, it was clear that the majority of parents did take a keen interest in the education of their children at the three schools. Henderson and Mapp (2002, p. 38) stated that “When school, families, and communities work together to support learning, children tend to do better in school, stay in school longer and like school more”. There is a positive and convincing relationship between family involvement and benefits for student, including academic achievement. This was confirmed by a teacher who said: *“We have parents" evening where parents are allowed to come to school and view the work of their children and engage a one-on-one discussion with the teacher. The parents are also informed of the whole assessment programme for the year and are given email address to contact the school or teacher at any time and set up another meeting. There is D-9 Communication software that parents get linked up with and get the latest available news of the school and sports activities. The other teacher mentioned that all learners have a homework book and there is space for parent to sign.”* With follow-up question it was clarified that the parent are allowed to come to braai activities and at the beginning of the year the principals call the parent, introduce them to the whole school staff and provide that parents with relevant information pertaining to how the school operates. The participants were able to motivate and provides evidence that there is a close relationship between parents

and the school (visitors register). It was indicated that the parents ensure that their children wear the school uniform and are fully in support of the school as a place where teaching and learning takes place. It was clear that participants understood that as teacher they have a responsibility to provide quality education to learners to increase their knowledge and understanding of the demands of schooling.

Participants also indicated that, they make it a point to provide the parents with feedback of what is happening during teaching and learning. They go an extra step and invite patents personally to come to the school to view their children‟s work. Teacher C commented as follows: *"our parents are fully committed in the schooling of their children and participate at different levels with the school. We also give learners reading texts which must be monitored at home as homework and parents have mentioned that they enjoyed listening to their children reading to them."*

In this case, the extent of parental involvement is substantive, inclusionary and participatory. Parents are fully involved in the life of the school and of their child‟s school education. This finding is consistent with literature on the oral of parents in school education (Henderson & Mapp, 2002) and the need for parental involvement, both for the school as well as the learners. This is further echoed by Swap (1993) who mentions that effective parent engagement must be comprehensive in nature, with the school consistently interfacing with parents at many points, in many venues, over the course of the schooling.

4.8.2 Role of socio economic issues

Socio economic factors play a role in the lives of learners and schooling. The education that is provide in these schools and their geographical positioning seems to suggest that these schools are well-off in terms of wealth and have an abundance of resources for their children to utilize, including sufficient teaching and learning material. This idea was highlighted by the following comment from a participant in the study, "*The majority of our learners come from wealthy families. This can be seen by the amount of school fees they pay and the parents give donations to the school".* Consistent with this, I also saw very expensive cars dropping off some learners at the school gates in the morning.

The implication of this is that the teaching and learning environment is very conducive for learning and that these learners are also exposed to other learning resources such as additional classes and tuition because their parents can afford it. This provides evidence to the argument that social factors do play a pivotal role with regard to the factors that influences the increasing performance of learners.

4.8.3 The learner in the school

The learners have achieved well in the past three years (see figure 4.1). The learners have taken a keen interest in their schooling because some even perform well in Grade 12 and are placed in the top ten of the province. Others are entered for external Mathematics competitions and also achieve well. The teachers confirmed that learners in their in their school do perform well and are well-behaved. The learners start their schooling from Grade R and they are integrated into the schools‟ ethos of performing well. The family status such as socio-economic status and parental level of education have been regarded as forecasters of children‟s academic achievement of influencing children‟s school outcomes (Miller & Almon, 2009). In agreement with Arnold and Doctoroff (2003) it is shown that parents‟ level education is the most important factor affecting students‟ academic achievement. Onocha (1985) mentions that a child from a well-educated family with high socio-economic status is more likely to perform better than a child from an illiterate family. This is because the child from an educated family has much support, such as a decent and good environment for academic work, which is conducive for effective teaching and learning. This was observed in all three schools. There are no more than 25 learners per class. They have a computer room, do Cami Mathematics on their own and they can for extra classes in Mathematics. The parental support and control was seen when observing how they arrive at school and during the interviews it was also confirmed that the parents take a keen interest in their children‟s education and also help with homework and come to the school to check their children‟s education and also help with homework and come to the school to check their children‟s work. They are kept well-informed about the activities that take place through various means of communication, such as emails and cell phone messages. The parent is likely to send his/her children to good schools where well-seasoned teachers will handle his or her subjects as in the case of these 3 schools where some of the teachers have 23 years of experience in teaching and especially Mathematics teaching at Grade 6 level.

Therefore, the learners in these schools doe achieve well because of the parental support, schooling environment and the experience of teachers who contribute to the achievement of these learners.

4.9 Discussion of findings

From the ate collected during the interviews, observations and the document analysis scrutinized, it because it became clear from the teachers who participated, that the increasing performance of learners is as a result of a combination of several factors. A significant aspect of research study is that there is a combination of factors within a school ecology that promotes performance of learners. Which this study commenced with a constructivist theoretical lens using Piaget and Vygotsky as the key theorist in guiding the study process, the findings suggests that no individual aspect of the constructivist understanding of teaching and learning can account for good learner performance. The combination and influential aspects of schooling can be more appropriately explained by employing Bronfenbrenner (1994) notion of ecology and the inter-relations among the contributing factors of the ecology that influences learner performance leaners performance. In this study, it was found that the teacher, the learners and the school environment are the key components of the ecology and they influence each other in significant ways to enhance learner performance.

The constructivist notion of learning believes that children can individually or collectively conduct knowledge and meaning in solving problems that s/he has encountered in his/her environment, Piaget‟s view is that social interaction has a positive impact in children‟s cognitive development. Like Piaget et al. (1962) Vygotsky‟s thinking is embedded in the idea that a child is an active learner within social spheres of learning influences. How each of these ideas come together and influences each other in a learning environment is the ripping edge. This is where Bronfenbrenner‟s ecological framework for learning comes into vogue to help explain how each inter-relates and influence each other to produces a learning environment that enhances learner performance.

Bronfenbrenner (1994) argues that the environment around a child‟s life affects his/her in growth and development. He considered the ecological environment to be like a series of nested Russian dolls whereby one is inside the other and the child is at the center of all the different relationship system. Thus, these systems are connected and each of them provides

opportunities and risks in the growth of the children. Lovett, Weldon, and Tonkin (2014) stated that according to Bronfenbrenner‟s ecological theory, the family has a crucial environmental effect on the child as family is regarded as a filter through which the society influences the child‟s development. The family has to support the goal of socializing the child and to protect him or her from harmful features in the society.

Bronfenbrenner (1994) argues that there are different systems within the child‟s development. Microsystem is the inner system which is closest to the child‟s daily life and consists of groups like local community, peers, family, church members or play groups. Through these groups, children are socialized and educated as they interact with different individuals in different contexts. Mesosystem is the next level relating to the interactions different individuals have with each other in the microsystem. On this level the child is not directly involved but is affected positively or negatively in his/her development. The exosystem follows the mesosystem, which is a much broader framework in which the child lives. On this level, the child is not directly involved, as it was in the microsystem but is affected in their development and socialisation. This involves the extended family members, neighbours, community services people, etc. These people act as support staff in parenting children, the last and outer levels is the macrosystem, which includes ideologies, laws, policies and custom of a particular culture that value the child. Bronfenbrenner (2005) described his level as a "societal blue-print for a particular culture". He added the chronosystem to his original model in acknowledging that human and physical ecologies change over a period, as there are different people and events that form part of history, the improvements in technology and new educational research have an impact on the way individual behave. This model means that the levels are interconnected and affect the child‟s development as the environments and the systems are continuously changing.

These schools have constantly performed well and their success can be related to the combination of factors, which are inter-linked with each other. These schools are in quintile 5 and are well established and sutured in Umlazi district. It is encouraging that the management of schools can be linked to the manner in which they perfume throughout the years.

It is evident that ANA was initiated as a diagnostic tool to assess how the education system is performing, because the current information that was available was regarding Grade 12 (matric) pass rate, which is published every year. Taylor (2011) mentions, that in the top quintile schools student are far more likely to have their own textbooks, receive homework more frequently, experience less teacher absenteeism, repeat fewer grades, live in urban area, speak English more frequently at home and have more educated parents. All these factors in, are more likely to contribute to the better performance of school in quintile 5 this is not surprising because the research study conducted supported the information mentioned above.

It became evident that the nature of engagement in the methods each school chooses to endure they deliver quality education to the learners is a significant factor. The schools made use of similar methods and the resource material make life more convenient for the learner, for example the white board and CAMI Mathematics and coupled with number of learners in the classroom, which is between 25-28 leaners per classroom. The teacher-learner ratio enables teachers to give individual attention to each learner. Morrow and Richards (1996) states that effective teaching takes place where there is one teacher face-to-face with about twenty or fewer learners for a specified period of time. The presentation of the teachers‟ lessons entailed learner interaction and group discussion, which allow learners to present the methods they used to solve the problem presented to their classmates. The infrastructure at each school is suitable and well managed by the school management team. The school are well managed and excellently organized in order to function efficiently at all times.

The teachers have sufficient knowledge of teaching the subject. The teachers are accountable to play their part in the school, managing the responsibilities assigned to then and working as a team with school management. This was evident when they emphasized that the language of teaching and learning was important for learners to understand Mathematics language and know patterns that are formed when teaching Mathematics. They were also sufficiently qualified and had vast experience in teaching the subject for several years. It is important to note that social factors played a role in ensuring that their learners get quality education because the schools are prepared to pay and hire additional teacher to support the teaching and learning at schools. The educational opportunities provided at the sample schools help learners build a good foundation, which they carry through to higher classes.

The ANA testing was introduced to try to address the low performance of leaners in internationally set assessment, where South Africa underperformed as compared to neighbouring countries that were economically disadvantaged compared to South Africa. Therefore, ANA is seen as a tool to help address issues of underperforming schools and be able to come up with plans to help schools function in an acceptable manner. When bearing in mind the complexity of factors, which influence teaching and learning it is clear that time, effort and thought is required to make a success of the learning.

The issue of assessment has become a cause of disagreement because the department is not sure of the quality and standard of tests set at schools. It then became necessary to have a national question paper set to ensure that the same standards are set throughout the country. Killen (2006) sate that this means that teachers need to describe and understand the purpose of each assessment task it terms of who it provide evidence about present understanding and learners‟ development towards lasting results. The interviews indicate it is important to mention that the teachers are aware of their obligation to achieve teaching by ensuring the support for leaners in all facets relating to teaching.

Another contributing factor is the management of monitoring what happens inside the classroom. The mere fact that they ensure teachers submit weekly plans and the Head of Department sits in on some of the lessons conducted does not necessarily indicated that quality teaching is happening. The school becomes aware of what quality of teaching is taking place in classroom and how effectively resources are utilised by the teachers is utilized. The schools are then able to keep up with latest technology, interesting teaching methods and the internet for teachers and learners to allow for additional research on other learning sites for Mathematics.

According to Morrow and Richards (1996, p. 154 indicates that “when numbers rise to forty and above teachers see themselves as deficient in the teaching and learning situation. Many teachers in such situations are overcome by despair and despondency and simply cease to care”. What the answer is to effective teaching in overcrowded classroom in poverty stricken environment, is yet to be found. Nevertheless, what is encouraging is the fact that the school management of such environment has significant knowledge and insight in curriculum development within the education system.

4.10 Conclusion

This chapter is intended to explain the results of the themes that emerged from the data generation with teachers during the interviews that were conducted at their schools. This was further heightened by the quotations that were provided by teachers and documentation analyses. The ANA has brought about changes in assessment strategies, because it emphasises that learners‟ assessment should be linked to the outcomes of the learning area of the content, with the focus on the learner demonstrating his/her ability to utilise newly found knowledge and skill. The research question was answered relating to the factors that influence the increasing performance of learners in Mathematics at Grade 6. The next and final chapter offers summaries, the conclusion, the recommendations and the value of this research.

CHAPTER 5
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In chapter four, an analysis and interpretation of the data collected on ANA testing was presented: data was collected from three schools and four teachers involved in the teaching of Mathematics at the Grade 6 levels in primary schools in the Umlazi District in KwaZulu-Natal Province. The information gathered assisted with the answering of the research questions. This was done to achieve the aims of the study, namely:

The aims of the study have been achieved by the presentation of the literature study on the Annual National Assessment (chapter two), the investigation into increasing performance of learners in the Umlazi district and the analysis and interpretation of the results of the interviews, observation and document analysis (chapter four).

In chapter 5, a summary of the study is presented. The conclusions are drawn on the factors pertaining to the increasing performance by learners in the ANA testing in Mathematics at Grade 6 level. This is followed by recommendations to enhance the benefits of ANA on a larger scale. The limitations of the study are highlighted and suggestions are made for further research.

The finding suggests that:

- What are the factors that influence the increasing performance in ANA testing at Grade 6 in Mathematics?
- How do these factors influence the increasing performance in ANA testing at Grade 6 Mathematics?
- What explains the influence of these factors on performance in ANA in Grade 6 Mathematics?

There is no individual aspect of the constructivist understanding of teaching and learning can account for good learner performance. It was found that the teacher, the learner and the school environment are the key components of the ecology and they influenced each other in significant ways to enhance learner performance.

These three schools have consistently performed well and their success can be related to the following combination of factors which are inter-linked with each other. The teachers have attributes of the following in no particular order:

- Some requisite level of professionalism (values)
- The inclination to teach (attitudes and desires),
- The ability to teach (knowledge , skills and pedagogy), and therefore,
- The competence to teach (imparting and instilling the knowledge, skills and values learners should be acquiring at school)

The above attributes were complemented with teacher vast experience in teaching the subject Mathematics at Grade 6 level. The language of teaching and learning is English in all three schools and this can be regarded as a contributing factor because from grade 1 they are taught in English and learners have a good command of the language. The language issue was supported by one of the participants where she said Teacher A describes the importance of understanding Mathematics in the following way, *"You got to understand that these learners come from a very good foundation phase, where everything to begin with, new concepts are taught through real life problems and children are taught to think for themselves and they are taught to read using sacker linguistic approach which is reading for meaning and understanding so right at the beginning they are exposed to vocabulary, exposed to patterns and they talk about mathematics".*

The learners" attitude and behaviours had a tremendous role in the teaching of mathematics. The participants in all three schools revealed that there was a good support they received from the parents with regards the learners" homework, extra classes, and coming to school to view learners work this participation of parents in their learners work has an impact in the performance of learners.

Research in the field of education leadership and management (Wedekind, 2012) has suggested that strong leadership is the key to school efficiency that is ultimately reflected in the leaners" performance. The three schools all had strong leadership and good management of the school this was revealed by participants when they mentioned that line function and role and responsibilities are clearly defined by schools. The school infrastructure was also identified as key area to provide a conducive environment to facilitate teaching and learning. The availability of teaching resources contributed to the performance of learners.

Two participants did critise the department of education with regards the manner in which workshops for ANA are organized they felt they were a waste of time because the deliberations because they do not gain anything form those workshops.

5.2 Summary

The purpose of the study was to investigate what are the factors that influence the increasing performance in ANA testing at Grade 6 level in Mathematics. The aim of the study was to investigate the assessment performance of learners in Mathematics at Grade 6 level who continuously perform well in the ANA testing, and to determine the factors, which contribute to these schools consistently performing above average. The researcher looked into factors such as the role of the teachers, experience, professionalism in the teaching of Mathematics, who the learners are in terms of learning the subject and the attitude of learners. Other significant factors are, how does the school operate and how is it organized, the nature of engagement regarding the teaching and learning, the parental involvement with regards to their expectations of the school and what they want their children to achieve and the socio economic status of the school and parents, and the community at large and other stakeholders at school for the increasing performing of learners. A literature review related to the purpose of the study was presented in chapter two.

It became apparent that the teachers‟ historical experience in the subject Mathematics and mathematical knowledge for teaching contributed to the manner in which they conducted their teaching in the classrooms and throughout the years made a contribution to the performance of learners. The teachers‟ professionalism in their careers as teachers plays an important role in how they conduct themselves in the teaching profession. They were experienced, which influenced their role in the choice of methods they chose to deliver the curriculum content. The teachers displayed professionalism in the commitment to their teaching and have a good attitude with regards to their teaching. The teachers were concerned about the manner in which ANA test was conducted, especially with the type of content that was assessed, the period when the ANA is written and the manner in which the memorandum was used during marking. They indicate that it was too prescriptive and did not allow for other creative methods in solving the Mathematics problems. Some said some of the schools have not yet taught the content evaluated.

However, when questioned about the issues they were adamant that proper planning by schools allow them to be able to make full coverage of the curriculum syllabi. There is much publicity about the ANA results and the existing research already conducted by other researchers‟ shows that there is little evidence that there are some schools, which are performing exceptionally well regarding the ANA testing. This is confirmed by the external verification that the schools have undergone and received after their results were published.

This leads me to conclude that the experience and professionalism of these teachers interviewed, and the learners and parents contributed to the increasing performance of learners in Mathematics at Grade 6 level. The teachers regard themselves as facilitators making sure that learners achieve.

The learners‟ background contributed to the study because the majority of them came from wealthier homes and their parents have significant influence on their study. This is emphasized by the kind of education that they receive from the school they are attending. The learners received homework frequently and the parents contributed in the sense of helping them do their homework. This ensures that learners are given sufficient time at home to deal with their homework and are not distracted by other chores at home. They are given daily feedback on their homework to help understand concepts in a better manner. The learners are also exposed to television and the internet whereby they can do research on their own. The results of learners are continuously discussed with their parents who can also afford extra tuition for their children. The learners are given a head start in life because they are adequately prepared in their schooling and this helps some of them to adapt easily when they enter high school life because of the firm foundation they receive at Primary school. These learners attend grade R at the school and this helps them to start from the early age to understand the ethos of the school learners attend from grade R at the school and this helps them to start from an early age to understand the ethos of the school.

Schools are seen as places that provide quality education and are able to deal with the demands of education. The parents often describe the school as a place where their children will be provided with quality education because of the following: good leadership of the school, proper management of the school and the staff, excellent infrastructure that is conducive to teaching and learning, and the manner in which the work of the teachers is

monitored at the school. The school is fully aware of how it should be managed and all stakeholders understand their role and responsibilities at the school. There is a realistic expectation of how teaching and learning should be realized in the classroom and support is provided through the management team. The teachers spoke about the mutual respect that exists between the teachers and school management team, which helps them to work in a relaxed atmosphere at the school. The management team provides good leadership, which is coupled with demonstrating their role in dealing with issues effectively and consistently.

To conclude, the school plays a significant role in the factors that contribute to increasing performance of learners in Mathematics at Grade 6 level. The school has a combination of factors that contribute positively to the teaching and learning environment. The school environment is set up in such a way that the teachers, learners and parents work in a manner that allows each of them to give of their best in order for the school leadership interacts with the teachers and the manner in which the teachers are willing to comply with the rules and regulations of the school in order to provide quality education to the learners. The school faces various challenges but good management allows them to be regarded as some of the top schools in the province of KwaZulu-Natal.

In addition to testing Grade 6 learners, SACMEQ III Van der Berg (2008) also tested Grade 6 teachers. The analysis of this data showed that many South African Mathematics teachers have below basic levels of content knowledge, with a high proportion of teachers being unable to answer questions aimed at their learners. Grade 6 Mathematics teachers from quintile 1, 2 and 3 have similar levels of content knowledge to the average teacher in Mozambique, Zambia and Malawi, and have substantially lower content knowledge than teachers in Kenya, Zimbabwe, Uganda and Tanzania. Similarly, rural Mathematics teachers in South African have significantly lower level of content knowledge than rural Mathematics teachers in Swaziland, Tanzania, Uganda and Kenya. Given that the teacher and learners tests are scaled to be comparable, it is shocking to note that the top 5 percent of Grade 6 learners in South Africa (565 learners) scored higher marks on the same Mathematics test than the bottom 20 percent of Grade 6 Mathematics teachers in the sample (80 teachers). Given that teachers cannot teach what they do not know, these findings have severe implications for the quality of education in South Africa. Unless the content knowledge (and thereafter pedagogical content knowledge) of Mathematics teachers in poor and rural areas is

improved, it will be exceedingly difficult to raise learners achievement in these schools. The need for ANA stems from in expressions of concern or dissatisfaction with the current assessment standards within different schools, which may come from a variety of sources such as teachers, learners, parents, administrators, employers, educational systems or a combination of them.

The analysis of every South African dataset of educational achievement shows that there are in effect two different public school systems in South Africa. The smaller, better performing system accommodates the wealthiest 20-25 percent of learners who achieve much higher scores than the larger system, which caters to the poorest 75-80 percent of learners. These two education systems can be seen when splitting learners by wealth, socio-economic status, geographic location and language. While there are minor differences depending on which dimension one chooses to split the distribution, the overall picture of two very different schooling systems is quite clear. For example, the latest TIMSS, Mullis, Martin, Foy, and Arora (2012) study showed that the average Grade 9 pupil in KwaZulu-Natal was 2, 5 years‟ worth of learning behind the average Grade 9 learners in the Western Cape for Science, and that the average Grade 9 learners in the Eastern Cape are 1, 8 years‟ worth of learning behind the average pupil in Gauteng. Similarly, pre PIRLS, (N Spaull, 2013) showed that Grade 4 learners from rural areas and townships are two and a half years behind urban children in reading. The National School Effectiveness Study, CALDWELL et al., (2007) showed that Grade 3 pupils from former white schools scored higher on the same test than Grade 5 learners from former black schools, showing that already by the age of eight there are large inequalities in the educational outcomes of learners.

The teachers who participated stated that they are aware of their everyday responsibility in terms of teaching Mathematics as a subject and are accountable as professional teachers for the organization of the classroom, the quality of teaching and learning that takes place in the classroom, and support received under the leadership of the school management team. In this regards, the responsibility of the ANA testing was a priority to the school and the interviewed teachers made it a point that their learners participate and the learners are fully prepared to write the ANA test.

The participants in the investigation agreed that the introduction of the ANA was one of the major changes brought about into the assessment strategy of the DBE in order to assess how the learners are performing in relation to nation and international standards. They confirmed that ANA should be used as a diagnostic tool to help schools that are having poor performance to improve results.

The participants of the 3 primary schools in the Umlazi District mentioned the way of efficiently managing the ANA activities for improving the performance of learners. There are some factors, which encourage the success with which they are able to manage the ANA namely, suitable classrooms, satisfactory teaching and learning materials, teacher mathematical knowledge, learners‟ attitude to problem solving in the classroom and parental involvement in their children‟s education.

5.3 Conclusions drawn from the study

The conclusions to be drawn from the study are as follows:

There are a number of contributing factors that lead to the increased performance by learners in the ANA testing and they are a combination of the following as mentioned in the funnel page 54, the teacher, learner and school.

I found that the teachers‟ mathematical knowledge was related to the learners‟ achievement gains in Mathematics at Grade 6 level as is their experience in teaching the subject over a number of years contributed as factor to increased performance of learners. The teacher as a facilitator of learning gives more autonomy to learners. The teacher‟s professionalism, background, position within the school and lastly the teacher‟s role in problem solving demonstrates the appropriate method to solve problems. Shulman (1986b) mentioned that teachers should have three categories of subject matter knowledge which are content knowledge, pedagogical content knowledge and curriculum knowledge. The teachers at the 3 schools interviewed showed evidence of possessing all three categories as mentioned above.

The ANA testing allowed teachers to be aware of the standards of national assessment and be able to compare how their learners are performing compared to other schools and provinces.

The learners from the teachers‟ perspective were well motivated and have a good self-image. They have the ability to use innovative ways of solving problems relating to Mathematics. The learners were exposed to good learning facilities and the ethos of the school was conducive to teaching and learning. The learner‟s showed a willingness to work with other peers and be able to do homework. The learners were exposed to computers and other learning materials. Lester (1980) reported that reading skills contribute to verbal problem solving abilities and a single element among others such as verbal, numerical, memory and computation abilities are associated with and related to success in mathematical problem solving (Falokun, 1981). The learners from the three schools are exposed to reading at school from grade R.

Good leadership concerning managing the quality of teaching and learning that takes place in the school contributes to the performance of learners at the school. Henderson and Mapp (2002) draw convincing conclusions as to the qualities that successful schools‟ efforts entail in order to engage families. He mentioned that parental involvement in decision making and connecting parent engagement strategies to learning objectives. Reaching out to parents beyond the school, were found in schools where parent involvement is measurably high, in specific programmes that demonstrate effects on learning outcomes and in school that exhibit high levels of achievement. The analysis of the three schools indicated that parental involvement is consistent and the parents occasionally frequent the school to interact with their children‟s teachers and assist their children with extra classes and homework.

5.4 Significance and recommendations

This study is significant to several persons and structures. Hence, the recommendations emanating from this study are directed to the significant persons, parties and structures directing school education. The recommendations respond to the themes that emerged from answering the research questions, which is what are the factors that influence the increasing performance in ANA testing at Grade 6 level in Mathematics? The recommendations are grouped into three themes and could contribute to the improvement of testing in Mathematics in the province:

The Department of Education should find ways to provide schools with suitably qualified teachers to teach Mathematics. They should have adequate subject knowledge and content knowledge to ensure that the teaching and learning that takes place at school is effective and experienced teachers in teaching Mathematics as a subject. The teachers should be exposed to constant and continuous workshops‟ and seminars to learn new strategies in problem solving to meet the demands of the subjects and encourage professional Mathematics teachers.

The learner‟s participation in his or her schooling cannot be underestimated and the participation of learners in their learning should be encouraged and motivated at an early age to avoid the high dropout rate in the country. It is important to mention that primary school education is also important and starting from Grade R in the same school in order to grow up knowing the ethos of the school is an advantage. The learners must adapt to the language of Mathematics and be exposed to reading from an early age. The gap between the quintiles in terms of learning should be narrowed. A comparative study between the quintiles should be considered as a study to establish how the education system is performing.

The parents‟ participation in their children‟s schooling and the support provided to school does contribute to the performance of their children. The Department of Education should adequately provide schools with the basic teaching and learning resources, which are required for quality education in order for school management to manage the quality of teaching and learning.

5.5 Limitations of the study

This study has the following limitations:
The study has limitations in the sense that the data collected was focused on the teachers‟ perspective only this could be information that is biased and only one view, which is of the teacher. The schools that were selected have English as their Language of Learning and Teaching (LOLT) and these are wealthy schools in quintile 5. The purpose sample of 3 schools and 4 teachers represent a small group of participants in the research study. Because of time constraints, only two qualitatively oriented types of data collection were used, that is individual interviews, observation and document analysis. Due to financial constraints, the research was restricted to three primary schools in the Umlazi District. If more schools were involved in the research, different findings might have emerged. The study was only conducted in the Umlazi district of KZN. Possibly different findings might have existed on provincial level if the study was extended to the other twelve districts of KZN. The results of the study can therefore not be generalized to a larger, provincially based population.

5.6 Recommendations for further research

The study has achieved its aim, that is, determining the factors that influence the performance is ANA testing at Grade 6 in Mathematics. The following suggestions are made for further investigation:

Due to the study‟s confinement to primary schools in the Umlazi district of it is suggested that the study be extended to the other twelve districts of KZN to assess whether different findings may be reached regarding the primary schools increasing performance of learners in the ANA, particularly in the Mathematics assessment that is done nationally in September by the DBE.

A study should be conducted on sustainable ways for the Department of Education to increase the number of teachers, provide the voice of the school management and the learners who are involved in the conducting of the ANA testing at primary schools. Good leadership versus school performance must be further investigated. A further study that can be

considered is a case study of one of the 3 schools to investigative the relationship between teachers‟ subject knowledge and the performance of learners in Mathematics.

5.7 Final synthesis

The studying of ANA testing in Mathematics is something that needs to be addressed urgently. Spaull (2015) argues that the state of Mathematics education in South Africa is nothing other than dire. Researchers like Howie and Hughes (1998), Reddy (2006), Fleisch (2008), Spaull (2013a), Ally and Christiansen (2013) argue that any attempt to raise students‟ Mathematical proficiency must first address these deficits if they are to be successful. Learners acquire learning deficits early on in their schooling careers and these backlogs are the root cause of underperformance in their later years. While the above statement can be regarded as factual because of the research currently done on underperforming schools, there are pockets of schools, which are performing consistently well. This is because of the early foundation teaching that is in place. For example, school 1, 2 and 3 of this research. This raises many other issues that need to be highlighted that is who addresses the cry of well performing schools and how they can be encouraged to continue performing well and raise the bar. The research question posed is what are the factors that influence the increasing performance in Annual National Assessment testing at Grade 6 in Mathematics. This question needs to be further explored in the quest to highlight that there are school, which are doing a good job in terms of teaching, and learning and their silent voices must be heard.

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APPENDICS

APPENDICES

APPENDIX A: ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

09 October 2014

Mr Raymond Cedrick Penniston 212561247
School of Education
Edgewood Campus

Protocol reference number: HSS/1159/014M
Project title: The factors that influence the increasing performance in Annual National Assessment testing at Grade 6 in Mathematics.

Dear Mr Penniston

Expedited Approval

In response to your application dated 12 September 2014, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

Please note: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Shenuka Singh (Chair)

/px

cc Supervisor: Dr LR Maharajh
cc Co-Supervisor: Professor L Ramrathan
cc Academic Leader Research: Dr P Morojele
cc School Administrator: Mr Thoba Mthembu

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

APPENDIX B: INFORMED CONSENT LETTER FOR PRINCIPALS

University of KwaZulu-Natal
Edgewood Campus
P/Box X03
Ashwood
3605
12 March 2014

Dear Principal

Re: Permission to conduct a Research Project in your School

I would like to request for permission to conduct a research at you institution. I would like to apoligise in advance for any inconvenience I might cause on my side. Hopefully the research will not disturb the smooth running of the school.

The research intends to address the following: The factors that influence the increasing performance in Annual National Assessment Testing at Grade 6 in Mathematics.

My plan is to interview the teacher in your schools who are teaching grade 6 Mathematics. This piece of research is part of my Master's Degree studies. I would like to assure you that information gathered will be treated with utmost confidentiality. I am bound by ethical standard of conducting research not to reveal any information gathered, furthermore the dignity, privacy and interest of the participants will be respected.

For more information you can contact my supervisor Professor L Ramrathan on 031 260 8065 or at ramrathanp@ukzn.ac.za

Thanking you in advance
If you agree to offer me this permission please indicate that you are informed about the study by providing your signature bellow. I understand the purpose of the study and hereby give consent to participate.

Name: _____

Signature: _____ date: _____

Yours faithfully

Raymond C. Penniston

APPENDIX C: INFORMED CONSENT LETTER FOR PARTICIPANT

Social Sciences, College of Humanities,
University of KwaZulu-Natal,
Pietermaritzburg Campus,

Dear Participant

INFORMED CONSENT LETTER

My name is Raymond Cedrick Penniston. I am studying towards a Masters Degree in Education (Curriculum Studies) at University of KwaZulu-Natal, Edgewood campus, South Africa.
My engagement with you is to ascertain the factors that influence the performance of learners in the Annual National Assessment test at Grade 6 in Mathematics in the Umlazi district in KwaZulu –Natal. I have chosen your school as one of my case studies. To gather the information, I would be asking you some questions on this subject.
Please note that:

- Your confidentiality is guaranteed as your inputs will not be attributed to you in person, but reported only as a population member opinion.
- The interview may last for about 30 minutes and may be split depending on your preference.
- Any information given by you cannot be used against you, and the collected data will be used for purposes of this research only.
- Data will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research. You will not be penalized for taking such an action.
- The research aims at knowing the challenges of your community relating to resource scarcity, peoples' movement, and effects on peace.
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.
- If you are willing to be interviewed, please indicate (by ticking as applicable) whether or not you are willing to allow the interview to be recorded by the following equipment:

	willing	Not willing
Audio equipment		
Photographic equipment		
Video equipment		

I can be contacted at:
Email: raypeniston@ymail.com
Cell: 0823589036

My supervisor is Prof. Labby Ramrathan who is located at the Discipline of Education Studies, Edgewood campus of the University of KwaZulu-Natal.
Contact details: email: RAMRATHANP@ukzn.ac.za Phone number: 031 260 8065

You may also contact the Research Office through:
P. Mohun
HSSREC Research Office,

Tel: 031 260 4557 E-mail: mohunp@ukzn.ac.za

Thank you for your contribution to this research.

DECLARATION

I..... (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT **DATE**

....

APPENDIX D: INTERVIEW QUESTIONS

SECTION A

INTERVIEW SCHEDULE FOR TEACHERS

TITLE OF THE STUDY: THE FACTORS THAT INFLUENCE THE INCREASING PERFORMANCE IN ANNUAL NATIONAL ASSESSMENT TESTING AT GRADE 6 IN MATHEMATICS

The purpose of the interview is to understand what are the factors that influence the increasing performance in Annual National Assessment testing at grade 6 in mathematics.

SECTION A

A.BIOGRAPHICAL DETAILS

1. Age group :

0 -19	20- 29	30-39	40 -49	50-59	60-69	70+
1	2	3	4	5	6	7

2. Gender :

MALE	FEMALE
1	2

3. Marital status :

SINGLE	MARRIED	DIVORCED	WIDOWED
1	2	3	4

4. Education :

4.1	Matriculation	
4.2	Diploma (Specify)	
4.3	Undergraduate (Specify)	
4.4	Postgraduate (Specify)	
4.5	Other (Specify)	

5. Number of years teaching :

0-9	10-19	20-29	30 -39	54+
1	2	3	4	5

SECTION: B

1. Why did you choose to teach mathematics?
2. How long have you been teaching mathematics at grade 6 level?
3. Where did you study to become a mathematics teacher, i.e. what are your qualifications in mathematics?
4. How many schools have you taught mathematics in?
5. Do you enjoy teaching mathematics? If given a, choice would you teach another subject?

SECTION C

1. What methods do you use to teach mathematics? Is it learner centred approach or teacher centred approach?
2. Did you receive any special training to teach mathematics?
3. Where did you get this training to teach mathematics?
4. Do you attend workshops on mathematics for grade 6 level teaching? If you do, how often? Who organises the workshop? Do you benefit from the workshop?

SECTION D

1. Tell me about the role of the learner in mathematics class.
2. How is the attitude of your learners towards mathematics?
3. How is their behaviour of learners towards mathematics in the classroom?
4. Besides what you have already told me, are there any specific challenges that you experience in teaching mathematics at grade 6 level?

SECTION E

5. To what extend has the assessment shaped and organized your teaching of the subject to increase performance?
6. How do you relate to the curriculum demands that pose a challenge in the performance of learners?
7. How prepared are the learners in terms of the coverage of the curriculum to write the annual national assessment test?
8. What support do you receive from the school and parents?
9. How effective is homework when given in terms of learning or reinforcing learning?
10. Is the design of the assessment capable of catering for a wide range of abilities of learners?
11. Does the school participate in the provincial assessment programme?
12. Do you attend the in service training provided by the department of education?
13. Does the school have sufficient learner teacher support material (LTSM briefly explain
14. What are the main aspects of Ana that have impacted on your assessment?
15. What are the factors that contribute to the good performance of the school in the assessment programme of ANA?
16. What suggestions do you have in order for ANA results to increase in the future?

APPENDIX E: LETTER FROM THE DEPARTMENT OF EDUCATION

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Nomangisi Ngubane | Tel: 033 392 1004 | Ref.:2/4/8/276

Mrs RC Penniston
34 Kisson Road
Ottawa
DURBAN
4339

Dear Mrs Penniston

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"THE FACTORS THAT INFLUENCE THE PERFORMANCE IN ANNUAL NATIONAL ASSESSMENT TESTING AT GRADE 6 IN MATHEMATICS"**, in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 01 October 2014 to 30 November 2015.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss. Connie Kehologile at the contact numbers below.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report / dissertation / thesis must be submitted to the research office of the Department. Please address it to The Director-Resources Planning, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education (Umlazi District).

Orient Islamic School
Manor Gardens Primary School
Hartley Road Primary School
St Augustine Catholic Primary School
Werda Skool
Clareville Primary

Nkosinathi S.P. Sishi, PhD
Head of Department: Education
Date: 03 October 2014

KWAZULU-NATAL DEPARTMENT OF EDUCATION

POSTAL: Private Bag X 9137, Pietermaritzburg, 3200, KwaZulu-Natal, Republic of South Africa ...dedicated to service and performance
PHYSICAL: 247 Burger Street, Anton Lembede House, Pietermaritzburg, 3201. Tel. 033 392 1004 Fax: 033 392 1203
EMAIL ADDRESS: kehologile.connie@kzndoe.gov.za; CALL CENTRE: 0860 596 363;
WEBSITE: WWW.kzneducation.gov.za

APPENDIX F: A LETTER FROM THE EDITOR

Angela Bryan & Associates

6 La Vigna
Plantations
47 Shongweni Road
Hillcrest

Date: 21 January 2016

To whom it may concern

This is to certify that the Masters Dissertation: What are the Factors that Influence the Increasing Performance in Annual National Assessment Testing at Grade 6 Mathematics? written by Ray Peniston has been edited by me for language.

Currently an English teacher at a private Secondary school, Angela has a Bachelor's degree specialising in English and Psychology. Her clients include academics from a number of universities, some of which are UKZN, Medical School, Rhodes and NWU. She has edited numerous articles for oversea publications including several translations from foreign languages.

Please contact me should you require any further information.

Kind Regards

Angela Bryan

angelakirbybryan@gmail.com

0832983312