THE QUALITY INTERFACE BETWEEN PRIMARY AND SECONDARY PHASE MATHEMATICS AT PUBLIC SCHOOLS IN MAFUKUZELA GANDHI CIRCUIT IN KWAZULU-NATAL

by

SAVATHRIE MOODLEY

2017

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By

SAVATHRIE MOODLEY

Thesis in compliance with the requirements for Doctor of Philosophy Degree in Quality in the Department of Management Sciences, Durban University of Technology.

I declare that this thesis is my own work and has not been submitted for any other degree or examination at any other institution.

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Certificate of Oral Presentation

Mrs. Savathrie Moodley
of Durban University of Technology

has presented the paper entitled:

The Quality Interface Between Primary and Secondary Phase Mathematics
at Public Schools in KwaZulu-Natal

This is to confirm that Mrs. Savathrie Moodley, having presented the above paper; actively participated in the 21st Century Academic Forum Conference, held at the Clark Kerr Conference Center at the University of California, Berkeley August 21-23, 2014.

We invite Mrs. Moodley to join our organization to help us in our quest to better prepare students and researcher for the demands of the 21st century.

[redacted]

Thomas Lechner, Ph.D.
Academic Director

Certificate of Participation

This is to certify that

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Ms S. Moodley

participated in the

4th African Accounting and Finance Association Conference
(AAFA 2014)

A three-day international conference held from 3 - 5 September 2014 at Lord Charles Hotel, Somerset West, South Africa

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ABSTRACT

Quality has emerged as a necessity in education as we are faced with increasing competition and a demand for better quality of life. There is an enormous gap in South Africa's education system; 60% of South Africa's children do not reach the final matriculation school year. Many Grade 12 learners, despite being taught Mathematics, remain effectively mathematically illiterates. The ability to provide quality education is more than ever essential and there is at present a consensus for fundamental reforms in our education sector, with emphasis on Quality. The result of quality education is not only about achieving academic excellence but the total development of the learner. If education does not cater for the future needs and challenges of the new millennium then it is ineffective for the new generation. Low scores in Mathematics are a major concern as learners are not able to meet the challenges in secondary schools to pursue careers in Mathematics. South Africa was placed last out of 41 countries worldwide in terms of Mathematics performance in the Third International Mathematics and Science Study (TIMSS). The World Economic Forum has placed South Africa last amongst 62 countries on the quality of Mathematics and Science Education in their annual report in 2012. Apartheid in South Africa was a complex period that paved the way for the new education dispensation. A paradigm shift was thus imperative and challenging to a democratic South Africa. It is more than two decades into the 21st century and into a democratic South Africa. The effects of apartheid are visible in many areas, more so in education. This study is underpinned by the transformation agenda attached to curriculum policy reform in South Africa. There is an interface in respect of policy construction and Skills, knowledge, attitudes and values (SKAV) constitution from the Department of Education to primary and to secondary schools. The implementation of various curriculum reforms led to a decline in the pass rate of learners in the National Senior Certificate examinations and in the Annual National Assessment. Some of the serious problems articulated by teachers were inadequate subject training in Mathematics, lack of communication, job dissatisfaction and the demanding administrative workload. It is envisaged that the findings of this study will make recommendations for SKAV development in teaching and learning of Mathematics in primary and secondary schools. In this regard, a model to improve quality in Mathematics education was proposed. The ability of education to meet the needs of the future both at individual and societal level is one of the critical elements of quality education.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ABET	Adult basic education and training
AIDS	Auto-immune deficiency syndrome
ANA	Annual national assessment
AS	Assessment Standard
BCG	Boston consulting group
BRICS	Brazil, Russia, India, China and South Africa
BPR	Business Process Re-engineering
C2005	Curriculum 2005
CASS	Continuous assessment
CAPS	Curriculum and assessment policy statements
CEPD	Centre for education policy development
CNE	Christian national education
COAG	Council of Australian governments
CJCP	Centre for justice and crime prevention
CPD	Continuing professional development
DACST	Department of arts, culture, science and technology
DBE	Department of basic education
DET	Department of education and training (previous apartheid department for Blacks in urban areas)
DO	Developmental outcome
DoE	Department of education
DoL	Department of labour
DST	Department of science and technology
ELRC	Education labour and relations council
EO	Education officer
EWSE	External whole-school evaluation
FET	Further education and training
FMSLL	The family maths, science, literacy and life skills programme
GDP	Gross domestic product
GEAR	Growth, employment, and redistribution
GET	General education and training

GNU	Government of National Unity
HEI	Higher education institution
HEQC	Higher education quality committee
HIV	Human immuno-deficiency virus
HoA	House of assembly (previous apartheid department for whites)
HoD	House of delegates (previous apartheid department for Indians)
HSRC	Human sciences research council
ICT	Information communication technologies
IEA	International association for the evaluation of educational achievement
IKS	Indigenous knowledge systems
IQMS	Integrated quality management
ISS	Institute for security studies
ITE	Initial teaching education
ITP	Improving teacher programme
ITT	Initial teacher training
IWSE	Internal whole-school evaluation
JET	Joint education trust
LO	Learning outcome
MCK	Mathematical content knowledge
MDG	Millennium development goals
MEC	Member of the executive committee
NAPTOSA	National professional teachers' organisation of South Africa
NCES	National center for education statistics
NCS	National curriculum statement
NCTM	National council of teachers of mathematics
NEIMS	National education infrastructure management system
NQF	National qualification framework
NSC	National senior certificate
NSFAS-	National student financial aid scheme
NSOs	National statistical offices
OBE	Outcomes-based education
OECD	Organization for economic co-operation and development
OTP	Outstanding teacher programme

PMDS	Performance management and development system
PPN	Post-provisioning norm
PR	Process review
RDP	Reconstruction and development program
RME	Realistic mathematics education
RNCS	Revised national curriculum statement
SA	South Africa
SACE	South African council for educators
SACCI	South African chamber of commerce and industry
SADTU	South African democratic teachers' union
SAPS	South African police service
SDP	School development planning
SEM	Superintendent education management
SGB	School governing body
SIP	School improvement planning (SIP)
SKAV	Skills, knowledge, attitudes and values
SLEs	Specialist leaders of education
SMT	School management team
SPSS	Statistical package for the social sciences
SSIP	Senior secondary improvement programme
STEM	Science, technology, engineering, and mathematics
SWOT	Strengths, weaknesses, opportunities and threats
TCAPS	Traverse city area public schools
TIMSS	Trends in international mathematics and science study
TVET	Technical and vocational education and training
UK	United Kingdom
UMALUSI	Quality assurance authority for education and training curriculum of the NQF
UNDP	United Nations development programme
UNESCO	United Nations educational, scientific and cultural organization
UNICEF	United Nations children's fund
USA	United States of America
WPTPSD	White Paper on transforming public service delivery

LIST OF FIGURES

LIST OF TABLES

LIST OF ANNEXURES

CHAPTER 1

INTRODUCTION AND ORIENTATION TO THE STUDY

1.1 Introduction

This study traces how the Curriculum and Assessment Policy Statements (CAPS) Mathematics Policy is constructed and translated as it traverses the Department of Education (DoE), to the primary and secondary school nodes. This research aims to map the interface of these nodes in the construction of policy as well as in the constitution of competencies, especially in Mathematics when learners enter secondary school. Chapter One deals with the context of the research, namely the quality interface between primary and secondary phase Mathematics and how Mathematics is developed from primary to secondary schools in the changing landscape of education in a post-liberated South Africa (SA). Taylor (2010: 17) asserts that the legacy of apartheid has created a negative environment in South African schools. During the colonial rule and apartheid in SA, several restrictive education policies were introduced into law, the most notorious being the Bantu Education Act 1 of 1953 (later renamed the Black Education Act, 1953), which was a South African segregation law that legalized several aspects of the apartheid system. Its major provision was enforcing racially separated educational facilities in an attempt to marginalize all non-white South Africans to a life of subservience as mainly unskilled workers. In light of this, one of the major points of contention and debate during South Africa's period of negotiations in the early 1990s was how to transform the education system so that it serves all South African children equally in an environment free of discrimination. The Constitution of the Republic of South Africa (Act 108 0f 1996) is regarded as the most progressive constitution in the world. Enshrined in it is a set of principles on how SA should mete out the highest law of the country and ensure that the rights of every citizen are protected and promoted. Section 3(2) of the Constitution of RSA states that: All citizens are (a) equally entitled to the rights, privileges and benefits of citizenship; and (b) equally subject to the duties and responsibilities of citizenship. This means that all citizens are entitled to enjoy equal rights and benefits. The custodians responsible for ensuring that the rights of citizens are promoted are public servants. Public servants are employed by the state and are required to conduct themselves in an exemplary manner, as stated in Chapter 10 of the Constitution of South Africa and of the Batho Pele principles (White Paper on Transforming Public Service Delivery 1997).

This study focuses on the various processes involved in legislating the National Education Policy Act No. 27 of 1996 and the subsequent implementation of South Africa's national curriculum, known as CAPS, with specific reference to Mathematics. Mathematics is a fundamental part of acquisition and development in primary education. Chapter one outlines some of the factors that may impact on the development of Mathematics; the actual performance of learners in South Africa; teachers' experiences in the classroom; and lastly, support from the DoE. All of these factors form part of the findings of the study and are dealt with in Chapter Five. It is suggested that this focus on the social mechanisms affecting Mathematics and development may make an original contribution to the field. This chapter also discusses the aim and purpose of the research, scope of the study, followed by a summary of chapters in the thesis. The chapter concludes by summing up the impact and potential value of the study.

1.2 Clarification of key concepts

This research study refers to several concepts and terms which need clarification. These are explained below:

1.2.1 Curriculum

The word 'curriculum' originated as a Latin word, which m*eans "a race" or "the course of a race"* and by the seventeenth century, the University of Glasgow also referred to its *"course"* of study as a "curriculum", producing the first known use of the term in English in 1633 (Pinar, William, Patrick and Peter 1995: 4). Pinar *et al.* (1995: 5) also stated that by the nineteenth century European universities routinely referred to their *'curriculum'* to describe the complete course of study.

In 1994 the African National Congress (ANC's) discussion document, 'A policy framework for education and training' defined curriculum as follows: The curriculum is understood to be more than teaching and learning activities that take place in learning institutions. It should contribute to the development of learners who are prepared for the world of work and for active participation in the process of social and economic development (ANC 1994: 10).

The Department of Education defined curriculum, as a set of principles and guidelines which provides both a philosophical base and an organizational structure for curriculum development initiatives at all levels; be they nationally, provincially, community or school-based (DoE 1995: 2). The term curriculum includes the learner, the teachers, teaching and learning experiences within a learning environment. This definition of curriculum encapsulates the broad principles as advocated by the CAPS policy document for Mathematics.

1.2.2 Policy and policy-making

Since the policy process is a crucial element in educational planning, it is essential to clarify the concepts of "policy" and "policy-making" before proceeding any further. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO 2004: 17), policy is defined as an explicit or implicit single decision or group of decisions that may set out directives for guiding future decisions; initiate or retard action; or guide the implementation of previous decisions. Policy-making is the first step in any planning cycle and planners must appreciate the dynamics of policy formulation before they can design implementation and evaluation procedures effectively (UNESCO 2004: 18).

The Department of Education defined policy as the principles and government policy-making in the educational sphere, as well as the collection of laws and rules that govern the operation of education systems (DoE 119: 3). Policy-making, therefore, involves balancing a number of contradictory demands and soliciting support, or at least tolerance, from the many different segments of society, which have an interest in education (UNESCO 2004: 23). The intention of the post-apartheid government was to formulate and adopt an education policy that would benefit all learners in a new, democratic South Africa.

1.3 Context of the research

This study is concerned with the quality of teaching and learning Mathematics in primary and secondary schools. Its aim is to establish the current trends in Mathematics, mathematical teaching and learning practices in formal education so that, ultimately, recommendations can be made for bridging the gap between primary and secondary school Mathematics and teacher training and support from the DoE. In the changing face of education in post-apartheid South Africa, provision has been made by the government to democratize education and, in particular' to allow all learners equity of access to key competences in education. However, there are signs that all is not well at the level of implementation. For example, the low learner pass rate in Mathematics is a national problem and teachers are leaving the profession (Adams and Waghid 2005; Naidoo 2009). Since the dawn of democracy in 1994, new demands for social change were inevitable. Teaching and learning need to be adapted to 21st century skills demands because schools are not sufficiently preparing learners for non-routine and deep thinking tasks. Since this advent, teachers have been bombarded by reform after reform and one new educational policy after another.

The SA Minister of Education, Angelina Motshekga (DoE 2012a: 2), stated that in the South African situation, demands for education reform continue to be informed by the need to address and redress the legacy of apartheid and segregation. In particular, teachers do not appear to be coping with the new dispensation and changing curricula, and there are indications that they are generally demoralized and demotivated. Between 2005 and 2008 more than 24 750 teachers left the profession (Maluleka 2010: 6). It must be emphasized that the issue of Mathematics and development is complex and multi-faceted, and is not just a simple question of applying knowledge or skills. Teaching and learning Mathematics is a dynamic process. Society is dynamic. Hence, learner and teacher education should meet current changes in knowledge and skills. McLeod and Reynolds (2007: 583) contended that we are teaching and learning in times of overwhelming change; changes in the way we know, changes in the way we teach and changes in what is expected of teachers and learners. Ramphele (2015: 11) stated that it is important to start with quality teachers before being able to speak about quality education because you cannot give what you do not have. The DoE (2012b: 3) indicated that teacher performance at South African schools remains low and contributes significantly to learners' poor results. De Clercq (2008: 14) concurs that teacher quality is the most important factor in learner achievement. It is imperative that SA also focuses its attention on teachers and the quality of instruction. Therefore' the teaching and learning of teachers and learners is critical in building teacher confidence and the capacity to improve learners' Mathematics results in a dynamic curriculum.

1.4 Purpose of study

The purpose of this study is to explore the quality of teaching and learning Mathematics between primary and secondary schools at public schools and preparing learners for the secondary phase. The constructs of Mathematical proficiency provide a framework for understanding how successful learning depends on a multiplicity of competencies. It will highlight some of the current practices in primary school Mathematics education. This reasoning intends to provide an understanding of the practices and provide some insights into what hinders and enhances Mathematics education. It is imperative that learners enter secondary school with a secure foundation in Mathematics. Mathematics is a heavily layered subject where each new topic builds upon the previous ones and, once learners fall behind, catching up can be a serious problem. Learners often get a rude awakening in secondary school when their limited mathematical repertoire fails to provide the necessary tools to fully grasp the concepts in the secondary phase.

1.5 Aim and objectives of study

This study aims to explore the quality of teaching and learning Mathematics in selected public schools in the Mafukuzela Gandhi Circuit in KwaZulu-Natal. In order to achieve the above aim, the following objectives are addressed:

i. To ascertain the perceptions and expectations of primary and secondary school educators regarding the preparation of learners in Mathematics from primary to secondary school;

ii. To establish learners' perceptions, expectations and experiences of Mathematics at primary school level in preparing them for secondary school Mathematics;

iii. To determine learners' perceptions, expectations and experiences of Mathematics at secondary school level;

iv. To investigate the readiness of learners in Mathematics for the secondary phase;

v. To examine the extent to which the primary and secondary phase Mathematics results in the Annual National Assessment (ANA) and the National Senior Certificate (NSC) impact on quality teaching and learning in Mathematics as reported by the Department of Basic Education (DBE).

vi. To explore whether gaps exist between primary and secondary phase Mathematics. and

vii. How is policy constructed and translated in practice as it traverses from the DoE to schools?

Based on the findings of this study, a model will be developed to improve the quality teaching and learning at the interface between primary and secondary school Mathematics in a changing curriculum.

1.6 Overview of the empirical research

The research methodology for this study is described in detail in Chapter Four. An overview of the reasons for selecting a specific methodology is explained. It is a well-established fact that the researcher had to be involved in thorough research. It is crucial that a research methodology is used which is appropriate to the area of study. This would ensure that the objectives of the research are attained. The initial research included a consultation of literature from books, journal articles, government legislation, departmental circulars, periodicals, newspaper articles, documents, conference proceedings and national statistics.

Together with the literature review, a mixed method involving quantitative and qualitative approaches was employed as research methods. The quantitative method was used to get statistical data and the qualitative method was used to get a rich understanding of the status quo in the process of teaching and learning Mathematics at primary and secondary schools. The use of a variety of data collection methods enabled the researcher to get a better understanding of both the breadth and depth of the focus area of the study (Denzin and Lincoln, 1998: 34). Creswell (2014: 175) supports the triangulation of data.

1.7 Background

The school completion certificate presently awarded is the National Senior Certificate (NSC). Mathematics has had the highest failure rate in the NSC examinations over the recent years from 2012 to 2015 (DoE, 2016: 59). The Trends in Mathematics and Science Studies (TIMSS) results show that South Africa's poor performance in Mathematics was highlighted in the first three TIMSS reports, in 1995, 1999, and 2002 (Reddy 2006: 2). Forty-two countries participated in TIMSS 2011 at the Grade 8 level and South Africa, Honduras and Botswana administered the assessments at the Grade 9 level; South Africa was placed second last in the TIMSS results (Reddy, Zuze, Visser, Winnaar, Juan, Prinsloo, Arends and Rogers, 2015: 4). The current trend in Mathematics is largely an extension of an existing trend in the quality of Mathematics education generally. It is only appropriate to contextualize curriculum reforms which directly impact on the quality of teaching and learning in the change process that can shape the outcomes in Mathematical attainment. The contribution of this study will be in terms of a framework for bridging the gap between primary and secondary phase Mathematics. To advance in Mathematics achievement, it is first and foremost essential to ensure that all learners receive quality Mathematics education. The World Economic Forum has placed South Africa (SA) last amongst 62 countries on the quality of Mathematics and Science Education in their annual report in 2012. The Chairman of the Marang Centre for Mathematics and Science Education at the University of Witwatersrand, Professor Rollnick, outlined two problems regarding the quality of Mathematics education, namely learners are not taught to understand and apply Mathematics and teachers do not have the knowledge to teach Mathematics, which impacts on the standard of teaching. The Third International Mathematics and Science Study (TIMSS) Report suggests that SA learners have difficulty grasping key Mathematical concepts and 90% do not possess a basic Mathematical knowledge (Reddy 2012: 5).

In the World Economic Forum's Global Competitiveness Report, South Africa ranks 132nd out of 144 countries for its primary education and 143rd for the quality of its Science and Mathematics. The Department of Basic Education's (DBE) recorded only 15% of 12-year-olds (sixth graders) scored at or above the minimum proficiency on the language test and just 12% did Mathematics in the national literacy and numeracy tests in 2014. The starkest measure of South Africa's failure is the wide chasm that exists between between the rich and poor. Under apartheid, such inequality was by design. Since apartheid came to an end, a small percentage of black elite has accrued great wealth which has only widened the wealth gap.

Schools have poor equipment; lack libraries; have scarce resources; and almost 50% of all schools do not have proper toilets (Jansen and Taylor 2003: 12). Thousands of schools in South Africa lack the infrastructure necessary to provide learners with the quality education that they are legally entitled to receive. The DBE's National Education Infrastructure Management System (NEIMS) Report, published in May 2011, indicates that schools in the Eastern Cape and KwaZulu-Natal are in the worst condition. The NEIMS Report (2011: 1) also provides detailed statistics on the lack of resources at public schools across the country. It is noted in NEIMS that, of the 24 793 public schools:

- 3 544 schools do not have electricity, while a further 804 schools have an unreliable electricity source;
- 2 402 schools have no water supply, while a further 2 611 schools have an unreliable water supply;
- 913 do not have any ablution facilities, whilst 11 450 schools are still using pit latrine toilets;
- 22 938 schools do not have stocked libraries, whilst 19 541 do not even have space for a library;
- 21 021 schools do not have any laboratory facilities, whilst 1 231 schools have stocked laboratories;
- 2 703 schools have no fencing at all; and
- 19 037 schools do not have a computer centre, whilst a further 3 267 have a room designed as a computer centre but these are not stocked with computers.

Many of the inequalities created during apartheid remain today, 22 years into the new democracy. Educational deficiencies, socio-economic divisions, political and economic forces have all contributed to the gap between the rich and the poor.

The majority of the above schools is not conducive to learning and has undermined the ability of the learners to achieve adequate quality education, which is evident in the results of national tests and examinations.

1.8 Annual National Assessment (ANA)

Annual National Assessments were used to gauge how the system is performing against the attainment targets. As part of the Government's programme of action, National Assessments are conducted from Grades 1 to 6 and in Grade 9. The Department has set high measurable targets for learner attainment that serve as performance milestones. Professor Rollnick, emphasized that in order to pass, any pupil would need to show a good knowledge and understanding of Mathematics because learners are tested on their understanding and application of knowledge and not on whether they had merely memorized information. Table 1.1 below reflects the results in the ANA examinations over the last three years. The average percentage mark in Mathematics of Grade 6 learners at primary schools for each of the nine provinces in SA in 2012, 2013 and 2014 is shown in Table 1.1.

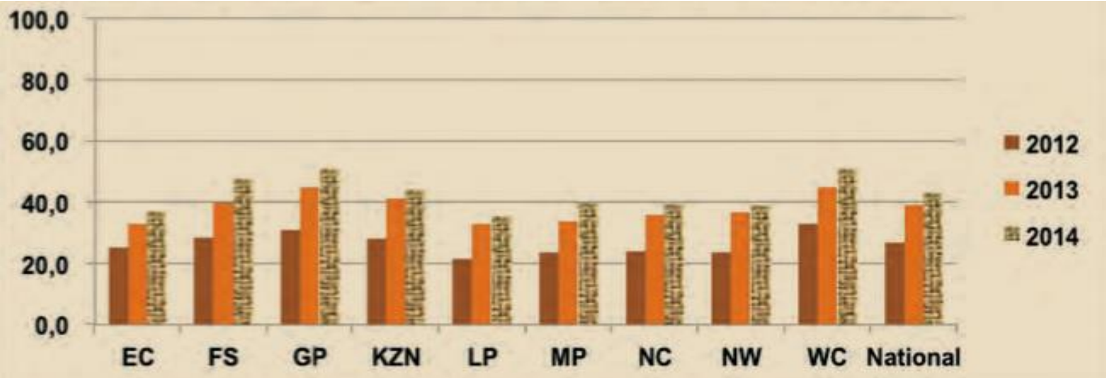
Table 1.1: **National results in ANA for Grade 6 Mathematics in 2012, 2013 and 2014**

PROVINCE	AVERAGE MARK (%)			
			2014	
	2012	2013	UNIVERSAL	VERIFICATION
EC	24.9	33.0	36.8	38.1
FS	28.4	40.0	47.7	48.2
GP	30.9	44.7	51.1	50.0
KZN	28.1	41.2	43.8	40.1
LP	21.4	32.9	35.3	32.8
MP	23.4	33.6	39.9	39.9
NC	23.8	35.6	39.3	41.6
NW	23.6	36.5	38.8	36.5
WC	32.7	44.9	50.9	41.8
National	**26.7**	**39**	**43.1**	**41.8**

Source: DoE (2015: 41)

The average percentage, nationally in Mathematics for Grade 6 learners at primary schools was 41.8% in 2014; 39% in 2013; and 26.7% in 2012. The failures for ANA in Mathematics were as follows: 58.2% in 2014; 61% in 2013; and 73.3% in 2012. KwaZulu-Natal had a low pass rate of 28.1% in 2012 and 40.1% in 2014. The generally poor Mathematics results indicated in Table 1.1, illustrates that there is a major problem in Mathematics teaching and learning.

Figure 1.1: **National ANA results Grade 6 Mathematics in 2012, 2013 and 2014**



Source: DoE (2015: 58)

The national average percentage of the Grade 6 ANA results ranged between 41.2% and 54.5%. Gauteng scored the highest mark. It is disturbing that almost half of South African learners are failing to meet the necessary requirements in skills, knowledge, attitudes and values (SKAVs) in Mathematics at primary school level.

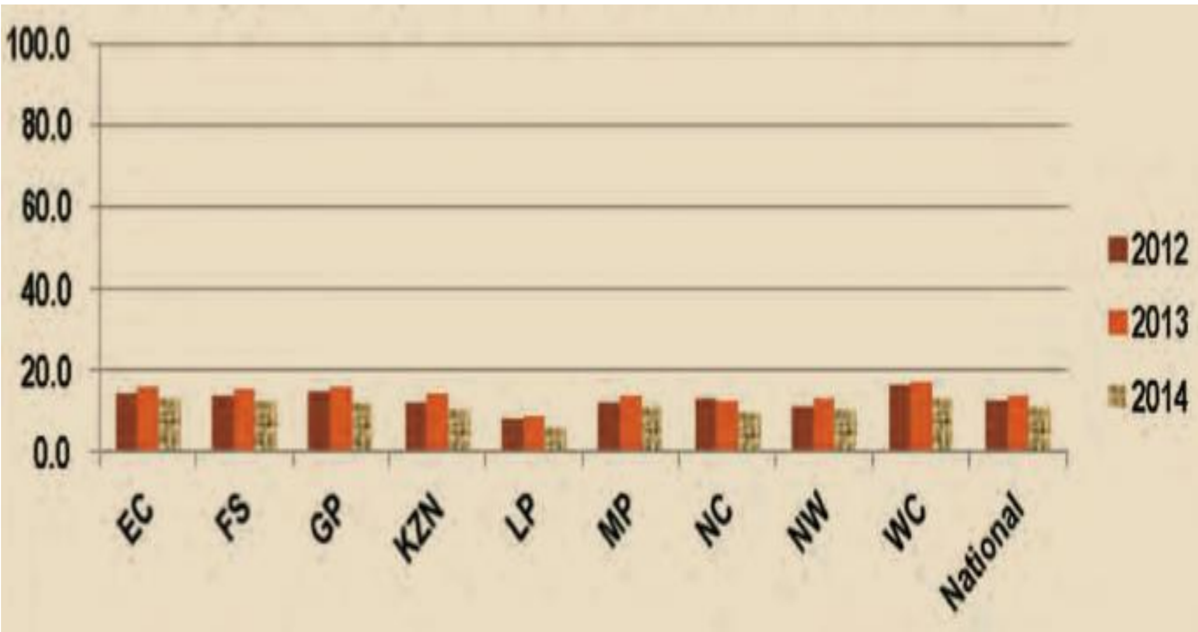
Table 1.2: Average percentage in Grade 9 Mathematics for each province in 2012, 2013 and 2014

PROVINCE	AVERAGE MARK (%)			
			2014	
	2012	2013	UNIVERSAL	VERIFICATION
EC	14.6	15.8	13.3	11.1
FS	14.0	15.3	12.9	13.8
GP	14.7	15.9	12.4	12.9
KZN	12.0	14.4	10.7	8.2
LP	8.5	9.0	5.9	6.5
MP	11.9	13.7	11.3	12.1
NC	13.2	12.6	9.7	9.7
NW	11.2	13.3	10.6	10.4
WC	16.7	17.0	13.0	11.9
National	**12.7**	**13.9**	**10.8**	**10.9**

Source: DoE (2015: 61)

The average percentage nationally in Mathematics for Grade 9 learners at secondary schools was 10.9% in 2014; 13.9% in 2013; and 12.7% in 2012. The failures for ANA in Mathematics were as follows: 89.1% in 2014, 86.1% in 2013 and 87.3% in 2012. KwaZulu-Natal had a very low pass rate of 12% in 2012; 14.4% in 2013; and 8.2% in 2014. With poor results as indicated in Table 1.2, illustrate that there may be a major problem with Mathematics at secondary schools. There is a decrease in the average pass rate from 41.8% in the primary school Grade 6 level to 10.9% at Grade 9 level in the secondary school phase. This alludes to the fact that learners' SKAVs in Mathematics from primary to secondary school is in dire straits.

Figure1.2: Provincial average percentage marks for Grade 9 Mathematics in 2012, 2013 and 2014



Source: DoE (2015: 61)

The universal score ranged between 5.9% and 13%, with the Western Cape scoring the highest mark of 13%. All nine provinces scored less than 20% in Grade 9 Mathematics from 2012 to 2014. The grade 9 Mathematics ANA results are poor in KwaZulu-Natal of 8.2% to 10.7%. Teaching and learning in Mathematics is in crisis nationally. The lack of improvement consecutively over the last three years confirms that Mathematics requires urgent attention in order to address the crisis in education.

1.9 National Senior Certificate (NSC) results

The National Senior Certificate (NSC) examination results also alerts one to a lurking crisis in terms of quality within the subject of Mathematics.

Table 1.3: **National Results in the National Senior Certificate (NSC) Exams in Mathematics and Mathematical Literacy in 2012, 2013 and 2014**

Year	No.wrote Maths	Achieved at 30% & over	Maths: % achieved	No. wrote Maths Lit	Achieved at 30% & over	Maths Lit: % achieved
2012	225 874	121 970	53.1 %	291 341	254 611	84.9 %
2013	241 509	142 666	58.3 %	324 097	282 270	85.8 %
2014	225 458	120 523	53.5 %	312 054	254 611	84.1 %
2015	263 903	129 481	49.1%	388 845	277 594	71.4%

Source: DoE (2015: 54)

Table 1.4: Provincial results in the National Senior Certificate (NSC) Exams in Mathematics and Mathematical Literacy for 2015

Province	Mathematics	Mathematical Literacy
Eastern Cape	42.0	77.1
Free State	65.8	90.5
Gauteng	69.3	93.7
KwaZulu-Natal	40.7	75.9
Limpopo	56.9	83.2
Mpumalanga	56.6	80.4
North West	61.7	90.0
Northern Cape	63.4	89.9
Western Cape	73.9	87.7

Source: DoE (2015: 61)

Learners need to obtain 30% to pass Mathematics or Mathematics Literacy in the NSC examination. In 2015; 134 422 matric learners and 2014; 104 935 matric learners, had not achieved a pass in the NSC examination in Mathematics. In 2015; 111 251 matric learners and in 2014; 57 443 matric learners had not passed the NSC examination in Mathematical Literacy. KwaZulu-Natal achieved the lowest pass rate in Mathematics which was 40.7%. Western Cape had the highest pass rate of 73.9%.

The findings from this study will disclose the status quo of the quality of teaching and learning in Mathematics. It is important to note that the SKAV required by learners is outlined in curriculum documents. If learners do not acquire the appropriate SKAVS in Mathematics; it would lead to the divergences in the partnerships that exist between the DoE and schools. The findings of the study indicate that they maybe to a certain extent an indirect partnership that exist between the DoE and schools at times. However, it is interesting to note that these partnerships exist at the level between schools and the DoE. The curriculum policy-making process was traced through the DoE, primary and secondary school nodes, specifically relating to the Mathematics Policy and not policies in general. Three areas became apparent:

- ❖ Methods of communication used during the policy-making process and their impact on policy negotiation;
- ❖ Involvement of stakeholders in the policy-making process as a result of methods of communication used; and
- ❖ Partnerships forged during the policy-making process as a result of methods of communication used.

The curriculum policy-making process is complex and involves various role players from the DoE; Government; Education Labour and Relations Council (ELRC); higher education; non-governmental organizations (NGOs); teacher unions and trade unions (DoE 2011: 3). The method of communication used by the DoE during policy negotiation impacts strongly on the involvement of stakeholders.

1.10 TIMSS Survey

The TIMSS survey from 1995 to 2002 has proved to be valuable experience for all the United Nations Development Programme (UNDP) supported participants, resulting in the creation of valuable indigenous capacity for organizing similar surveys at other grade-levels nationally and for participating in TIMSS 2007. According to Reddy (2006: 5), the TIMSS survey has already led to:

- ❖ meaningful educational reforms in curriculum, evaluation and assessment standards and tests and examinations, particularly in Egypt;
- ❖ reforms/changes in curriculum and testing and scoring methodologies have been instituted;
- ❖ a heightened awareness of the need for reforms in such areas as teaching

methodologies, teacher training and licensing;

- ❖ the adoption of new test formats and scoring methodologies;
- ❖ recognition of the urgent need for shifting the emphasis from rote learning to application of knowledge; and
- ❖ a renewed awareness of the essential need for educational reforms as a building block for a knowledge society.

Mathematics is a quantitative subject that fosters the development of cognitive abilities such as thinking (Shaffer 2001: 39). Reasoning skills are important for success in Mathematics as well as other subjects that learners study at schools. Mathematics, particularly, is a base for all scientific and technological studies. Furthermore, Mathematics has high relevance and practical application to many real-life situations and problems. It is therefore a key and compulsory subject in many school systems. In South Africa, Mathematics is a core subject at primary and secondary schools. Important as it may be, the study of Mathematics has not been easy for many learners. Similar to the rest of the world, learners in KwaZulu-Natal schools have a wide range of problems with Mathematics. Mathematics is one of the school subjects in which many learners often perform poorly. The current state of education is considered to be one of the main causes of concern and it has given rise to the need to formulate a new approach, one which places emphasis on quality in education.

1.11 Rationale for the study

The study was undertaken to ascertain the efficacy of the implementation of various curriculum policies with specific reference to teaching and learning of Mathematics in the post-apartheid South Africa. With the ushering in of a constitutional democracy in 1994, the transformation of South Africa’s system of education was one of the key priorities of the newly elected Government of National Unity (GNU). After decades of institutionalized racial discrimination, the GNU had to dismantle the divisive system of apartheid education in an endeavor to usher in a united nation with a shared vision. The generally unsatisfactory performance of Grade 12 learners in the National Senior Certificate Examination was a huge concern amongst all education stakeholders. In addition, the ongoing performance of South African learners in the Mathematics tests that were conducted in the TIMSS and ANA reveals poor performance. The poor pass rate in Mathematics suggests that the first NCS as a new curriculum policy and all other preceding curriculum policies were not effectively implemented and monitored by both the National and Provincial Departments of Education.

1.12 Quality in Education

Quality in education has been defined as ‘excellence in education, meeting or exceeding customer’s expectations of education’ (Parasuraman, Zeithaml and Berry 1985: 21) and ‘value addition in education’ (Feigenbaum 1951: 33). In his discussion of education quality, Cheng (2003: 204) focuses on the effectiveness of internal education processes, particularly teaching and learning. She explains that quality in education refers mainly to the achievement of planned education goals, particularly in terms of student outcomes. Cheng (2003: 204) adds that the higher achievement in planned education goals implies better quality in education. Reynolds, Lawrence, Thorton and Smith 2013: 17) emphasize that learners’ academic performance is influenced by the quality of education or instruction that they receive.

Two decades into the 21st century and into a democratic SA, quality has emerged as a necessity in education. People are faced with increasing competition and a demand for better quality products and services. According to The Family Maths Science Literacy in South Africa (Reynolds *et al*. 2013: 19), there is an enormous gap in South Africa’s education system where 60% of South African children do not reach the final school year; about 14.3 million South Africans aged 15 and over have had no schooling or did not reach grade 7; and many matriculants, despite being taught Mathematics and Science, remain effectively mathematically illiterate. An alarming 32% of the adult population, or 14.3 million adults, may be regarded as functionally illiterate. The ability to provide quality education is more essential than ever states Jansen (2004: 121). There is at present a consensus for fundamental reforms in our education sector, with emphasis on quality. At a time where sustainable development is being advocated as a prime objective for most governments around the world, it is recognized that education will have a critical role to play (UNESCO 2012: 15). The result of quality education is not about achieving high grades and mere academic excellence but the total development of the student. Cheng (2003: 205) states that if education does not cater for the future needs and challenges of the new millennium, then it is ineffective for the new generation. Cheng (2003: 209) concludes that the ability for education to meet the needs of the future both at an individual and societal level is one of the critical elements of quality in education. The World Economic Forum has placed South Africa (SA) last amongst 62 countries on the quality of Maths and Science Education in their annual report in 2012. The Third International Mathematics and Science Study (TIMSS) Report suggests that SA learners have difficulty grasping key Mathematical concepts and 90% do not possess a basic Mathematical knowledge, as opposed to the international average of less than 30% (Reddy 2006: 141). The government and the people of SA have been committed to expanding the education system to enable greater participation by all role players in development spheres. The education department has envisioned and prioritized quality basic education at all schools. A much greater focus on effective service delivery by government has resulted in the education sector being particularly tasked with achieving the outcome of quality basic education. The government has the obligation to provide its citizens with the opportunity to participate fully in the socio-economic and political development of the country and to attain a decent standard of living. Provision of such opportunities is largely achieved through the expansion of access to and participation in a nation's quality education system.

Mathematicians, Davis, Adler and Parker (2007: 50) perceive that the individuals who formulate new Mathematics programmes have lost sight of the core skills that early Mathematics education should be instilling, which is a systematic approach to dealing with abstract objects and which is being ignored. Jerald (2009: 15) states that academic knowledge and the skills taught form the core knowledge that is imperative in the teaching and learning of Mathematics. A solid education today demands not only a strong foundation or "core" in content knowledge but also the ability to apply it to the real world. Both are essential to develop broader competencies like critical thinking and problem solving (Jerald 2009: 17). It may not be the methods taught but the failure to first provide a solid grounding in traditional systematic algorithms in Mathematics. Van den Heuvel-Panhuizen (2012: 23) is of the view that the real problems in Mathematics may run much deeper and that abstraction is fundamental to Mathematics as it is what gives Mathematics its power and scope. Abstraction and abstract thinking are one of the core skills that Mathematics education should be imparting. It is the mechanism by which higher Mathematics builds upon elementary Mathematics. Jerald (2009: 18) argues that traditional skills in reading, writing, and arithmetic, "the three R's," provide the basic skills for a solid foundation in expert thinking and complex communication.

Raising the quality of primary Mathematics will ensure that all learners benefit from schooling through strategies based on high expectations of attainment, engagement and transition into secondary school. Van den Heuvel-Panhuizen (2012: 24) from the Freudenthal Institute in the Netherlands states that the enhancement of the quality of learning and teaching Mathematics and the quality of learning signifies that the subject matter knowledge and skills that learners have to learn should be meaningful. The quality of Mathematics education implies having adequate instructional settings, didactical models and tools available in the primary phase in order to achieve a high output in the secondary phase in terms of learners' competences and attitudes in Mathematics. UNESCO (2012: 19) advocates two goals for quality Mathematics education:

- ❖ To overcome the shortage of qualified Mathematics teachers; and
- ❖ To ensure access to basic education.

A much greater focus on effective service delivery by government has resulted in the education sector being particularly tasked with achieving the outcome of quality basic education to enhance Mathematics teachers' knowledge.

Quality is a problem from primary school through to higher education and low scores in Mathematics and Science are a major concern as learners are not be able to meet the challenges in secondary schools and tertiary institutions to pursue careers in Mathematics, Science and Technology. The Minister of Basic Education in SA, Angelina Motshekga (DoE 2012: 2) states that poor quality and outdated training for Mathematics teachers has escalated the problem and that further development and training for quality teaching in Mathematics is necessary. According to the DoE (2012b: 3), a solid foundation is paramount in Mathematics education and one of the priorities is to improve learner performance, particularly in primary schools. This problem is exacerbated when learners are unable to cope with Mathematics in the secondary phase. There is therefore a need to investigate the quality interface between primary and secondary phase Mathematics.

1.13 Limitations of the Study

This study has a few limitations that should be considered and that could inform future studies related to this one. The design of this study is limited in terms of instrumentation to measure the quality interface between primary and secondary phase Mathematics at public schools in the Mafukuzela-Gandhi Circuit in KwaZulu-Natal only. It was not possible to retrieve data from schools in the rural areas because of time constraints as data collection was done during school hours and no study time is allocated for teachers. The current study provides a glimpse into Mathematics at public schools in the Mafukuzela-Gandhi Circuit in KwaZulu-Natal. There is also considerable potential for further exploration of this relationship, as well as how this relationship might be associated with effective teaching in Mathematics.

Participants had limited time to complete the questionnaire as it was done during school time. However the researcher distributed a large number of questionnaires, which guaranteed that the target sample was reached. Therefore, in keeping with the principles of research, participants were not coerced to fill in questionnaires or grant interviews (Cohen, Manion and Morrison 2011: 261). The researcher also had limited opportunity to visit various schools due to time constraints.

1.14 Structure of the thesis

The study focuses on the quality interface between primary and secondary schools Mathematics. The following is a synopsis of each of the six chapters that comprise the study:

1.14.1 Chapter One: Introduction and orientation to the study

This chapter describes the structure of the study. A discussion of key concepts serve to introduce the research topic within the ambit of the NSC, ANA, and TIMSS is provided. The location of the study, which is undertaken against the backdrop of the KwaZulu-Natal Department of Education with specific reference to quality teaching and learning in Mathematics, is subsequently discussed. In addition, an explanation for the rationale of the study, problem statement, aims of the study, objectives and key questions to be asked are elaborated upon.

1.14.2 Chapter Two: Quality in education

Chapter Two examines South Africa's post-apartheid transformation of its education policy with the Curriculum and Assessment Policy Statements (CAPS) within the context of quality in education in Mathematics. A chronological account of various education policies beginning with the Bantu Education Act of 1953 to the implementation of the CAPS is discussed. In addition, a description of the challenges to curriculum development includes internal challenges of the education system is provided. Details of literature focusing on the quality interface between primary and secondary phase Mathematics and its relation to Mathematics education are also provided. The main study explores how the Mathematics CAPS policy document is constructed and translated as it traverses the DoE, primary and secondary school nodes and whether there is an interface in terms of policy construction, practice and SKAV constitution across the nodes. If so, the study explores the nature of the interface. The Chapter undertakes a comparative analysis of curriculum and assessment policy trends in both developing and developed countries, in order to draw parallels between South Africa's national curriculum and assessment policy and countries in sub-Saharan Africa and other international countries.

1.14.3 Chapter Three: Education in South Africa

Chapter three deals with education in an apartheid and post-apartheid South Africa. The literature review was guided by the transformative agenda attached to education reform in democracy that requires various structures such as the DoE and schools to promote quality education based on the Batho Pele Policy and to overcome past discrepancies. The chapter also deals primarily with the theoretical perspectives that underpin policy and public policy. A detailed discussion of the associated theories and models used to analyze public policy, with specific reference to South Africa's education policy after 1994 is undertaken. The search for a theoretical perspective to trace the construction of policy and the constitution of SKAV in practice was a challenge because the framework had to satisfy the above criteria theoretically, methodically and analytically.

1.14.4 Chapter Four Methodology

This chapter explores the research design adopted for this study. The methodology is discussed and justified, revolving around the research paradigm and data collection practices. The research methodology and the data analysis procedures are also explained. Issues related to the location of the research; the research paradigm; the quantitative and qualitative approaches; and triangulation were also discussed. Examples of data collection methods; the statistical tools and techniques used for analysis; and discussions thereof are also outlined in this chapter. The validity, reliability and ethical issues are also elucidated as they apply to this study.

1.14.5 Chapter Five: Statement of findings, interpretation and discussion of the primary data

Chapter five analyses and interprets the data obtained from both the quantitative and qualitative instruments used in the study. The data was analyzed and interpreted by the process of triangulating both the quantitative and qualitative data. The results are presented in the form of graphs, tables, cross tabulations and other diagrammatic representations. Inferential techniques including the use of correlations and chi-square test values; are interpreted and discussed in detail.

1.14.6 Chapter Six: Conclusions and recommendations

Chapter six presents conclusions drawn from the research study and makes recommendations that may be used for either future research or practical application. Emanating from the results of the study, a few pertinent recommendations are proposed. A model for future curriculum policy formulation, adoption, implementation and evaluation was developed. The cumulative impact of the adoption of this model would lead to effective curriculum policy delivery.

1.15 Conclusion

This Chapter provided a broad overview of the study. It also highlighted key concepts that were used in the study which played a pivotal role in assisting the researcher to focus on the topic at hand, that is the quality interface between primary and secondary phase Mathematics at public schools in KwaZulu-Natal. In addition, the locus, rationale, research questions, the research methodology as well as the limitations of the study were also elucidated. Finally, an overview of the structure of the thesis is provided. The subsequent chapter focuses on South Africa’s CAPS curriculum within the context of education.

CHAPTER 2
QUALITY IN EDUCATION

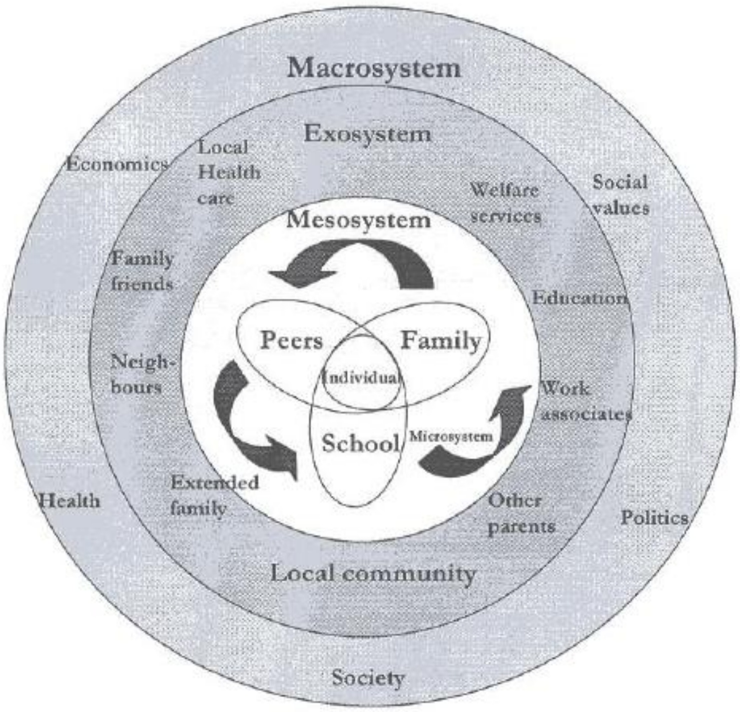
2.1 Introduction

This chapter begins with a description on the education environment surrounding learners' lives. This is followed by a discussion on quality assurance and its impact on Mathematics education. Details of the literature focusing on the quality interface between primary and secondary phase Mathematics and its relation to Mathematics education are also provided. The challenges to education and curriculum development, which include internal challenges of an education system; challenges specific to learning; and global economic challenges are analyzed. These may be found at three levels: the microlevel (school, Department of Education, DoE); mesolevel (interconnections between the microsystem interactions between the family and teachers and the relationship between the child's peers and the family); and macrolevel (culture in which individuals live and the global economy). This study focuses on challenges predominantly at the microlevel. If these challenges are not resolved at the microlevel, there are further ramifications for the mesolevel and macrolevel. The research further interrogated local and international studies in order to understand issues relating to the micro-level.

2.2 Microsystem, mesosystem, exosystem and macrosystem

At the centre of the microsystem, mesosystem, exosystem and macrosystem is a child who is influenced by each of the four levels on a daily basis. The microsystem refers to a child's immediate surroundings. In this context, these factors impact on each other and learners at large. These systems can be distinguished as the microsystem, mesosystem, exosystem and macrosystem as illustrated in Figure 2.4 (Swart and Pettipher 2005: 11). According to Swart and Pettipher (2005: 12)' the macrosystem is of importance because it includes the attitudes, beliefs, values and ideologies inherent in a community and culture and consequently has a pertinent impact on the meso, exo and microsystems. Bronfenbrenner (2013: 244) argues that the macrolevel, is grounded by and through the economy, politics, social health, social values, as well as the nature of the community and relevant circumstances which impact on learners, decisively determining their future expectations of learners.

Figure 2.1: Microsystem, mesosystem, exosystem and macrosystem



Source: Swart and Pettipher (2005: 11)

2.2.1 Schools in the microsystem

A learner's development is best understood by examining the context of the learner's environmental influences. The immediate environment, i.e. family and peers, have a direct influence on the learner's development. There are indirect environmental influences, such as the culture in which the child lives, that influence how a learner develops. A learner's own outlook also plays a role in his or her development. It is the interaction between these different environmental factors that determines how a learner will develop. Bronfenbrenner (2013: 245) states that the school system is made up of subsystems that include teachers, administrators, support personnel, school governing body (SGB) members and learners. The family system includes a marital, parental, sibling and, often, a grandparent subsystem. The peer system includes social friendships, academic friendships and sports or hobby friendships. The next layer of the system includes subsystems that the child does not directly experience but that affects the child because of the influence they exert on the microsystem. Chavkin and Williams (1993: 75) conducted a survey of over 3,000 parents in schools in the southern United States. They concluded that only about four percent of parents are active at school and the parents who are involved at school tend to be parents of elementary school children. Their involvement declines dramatically once children enter the fourth grade and involvement by parents in school activities is lowest in secondary school. Epstein (1995: 705) states that the beneficial effects of parent involvement principally improve academic achievement. The school, family and community are important spheres of influence on the learners' development and that a learner's educational development is enhanced when these three environments work collaboratively towards shared goals.

2.2.2 The mesosystem

According to Bronfenbrenner (2013: 246) and Swart and Pettipher (2005: 13), the mesosystem has interconnections between the microsystems; interactions between the family and teachers; and relationship between the child's peers and the family. When reflecting on the lives of the adolescent, the ecosystemic model in Figure 2.1 can be used to illustrate how the individual learner is trapped in a vicious cycle as there are factors in the immediate environment of the adolescent, namely the family, school, peer group and community and the mutual interactions between these factors. There are three main environmental systems. Epstein (1995: 705) argues that changes or problems in any one of the systems can cause changes in the others, which impacts on the individual learner.

2.2.3 The exosystem

The exosystem involves linkages between a social setting in which the individual does not have an active role and the individual's immediate context. Chavkin and Williams (1993: 77) use the example of a parent's or child's experience at home being influenced by the other parent's experiences at work. The parent might receive a promotion that requires more travel, which might increase conflict with the other parent and change patterns of interaction with the learner that ultimately impact on the learner's performance at school. A review of the literature on family involvement in education delineates several obstacles and barriers between parents and teachers that prevent them from communicating openly and working together effectively. Swart and Pettipher (2005: 15), Bronfenbrenner (2013: 247) and Epstein (1995: 707) have identified three categories of obstacles or barriers to family participation in the school activities of their children, namely: 1) limited skills and knowledge of teachers and parents; 2) restricted opportunities for interaction; and 3) psychological and cultural barriers. In order to alleviate the barriers to effective parent-teacher collaboration, teacher preparation development programs must provide course work which includes developing teachers' special knowledge, attitudes, skills and strategies to work effectively.

2.2.4 The macrosystem

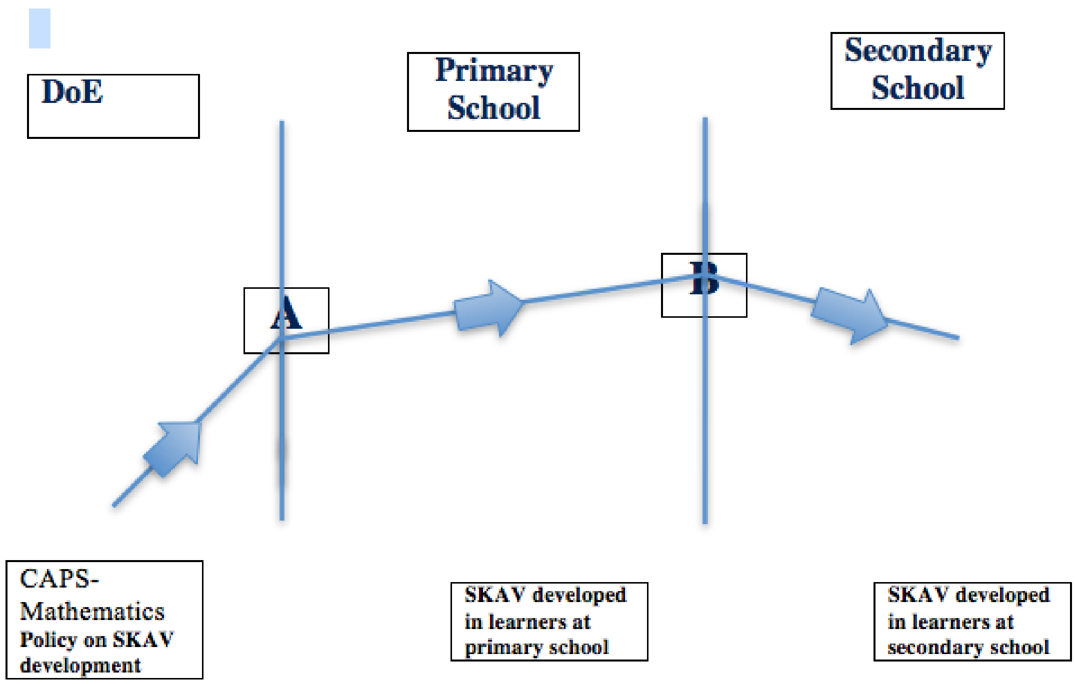
The macrosystem describes the culture in which individuals live. Cultural contexts include developing and industrialized countries, socio-economic status, poverty and ethnicity. A learner; his or her parents; his or her school, and his or her parents' workplace are all part of a large cultural context. Members of a cultural group share common identity, heritage and values. The macrosystem evolves over time because each successive generation may change the system, leading to their development in a unique macrosystem. This generation of technology with computers, i-Pads, cell phones and the internet has impacted on learners' focus at school.

Bronfenbrenner (2013: 246) views environmental factors as playing a major role in the development of the learner and explains how everything in a child and the child's environment affects how a child grows and develops. Swart and Pettipher (2005: 14) suggest that learning support will be implemented in the general classroom largely under the umbrella of a social systems model of support. Learning support is underpinned by the notion that inclusion is beneficial to all learners. The different aspects or levels of the environment that influence learners' development, including the microsystem, the mesosystem, the exosystem and the macrosystem, may impact negatively or positively on learners.

2.3 Interface

In physics, the term 'interface' refers to "a meeting point between two media of different optical densities" (Dufresne, Gerace and Mestre 2008: 2). The interface is construed as a meeting point between media of different optical densities. The interface is a meeting point (or point of convergence or divergence) of this study. When a light beam travels between media of different optical densities, such as from air to glass or vice versa, two things happen at the interface, namely it is reflected and refracted. The emergent ray at the point of refraction takes a different path than the initial incident ray. The emergent ray is a product of refraction. The optical density of the medium contributes to the deviation of the emergent ray from its intended path. However there are other role players such as parents, peers and teacher unions who also impact at the refracted areas. In other words, the light beam experiences a translation in its direction of travel. It is this change that the researcher focused on, particularly the change that is brought about by refraction at the different meeting points i.e. the DoE, primary school and secondary school, as illustrated in Figure 2.2.

Figure 2.2 Points of interface



Source: Self-generated by researcher

Knowing that the optical density of the medium determines the extent to which the light beam gets refracted, it becomes significant to ask what actually happens at the interface to cause the light beam to be refracted**.** Simply, refraction refers to the discontinuity that may occur when the curriculum and assessment policy statements (CAPS) document is cascaded from the DoE to primary and secondary schools. The optical density is determined by the factors within two media of optical densities. The phenomenon of interface is relevant to this study in terms of the interface between primary and secondary phase Mathematics. To map the interface between the DoE and primary school and secondary school, the light beam is equated to the CAPS document in Mathematics on skills, knowledge, attitudes and values (SKAV) development in Mathematics, while the DoE, primary school and secondary school are equated to the media with different optical densities.

In Figure 2.2, there are two points, i.e. A and B, where the interface occurs. Point A represents the interface between the DoE and schools while point B indicates the interface between primary school and secondary school. The degree of convergence or divergence that occurs at the point of interface will not be altered if the positions of the nodes are re-oriented in the figure. Re- orientating the nodes in the figure does not alter the optical density of that particular node. In this study, the practices at the DoE, primary and secondary schools are the implementation of policy. Haraway (1988: 576) maintains that the practice engaged in at each node entails learning. Bronfenbrenner (2013: 246) argues that learning arises out of a web of interactions at a particular location; in a particular practice; and all elements participate in the achievement of "learning". It must be noted that the optical density determines the extent to which the CAPS Mathematics Policy on SKAV development gets refracted i.e. it is disseminated at various points on the interface and the understanding of CAPS may become distorted in this process of dissemination. This idea of interface and refraction allowed the researcher to see the emergent effect of the CAPS document as it traverses from one medium to another, i.e. from the DoE to primary schools and then to secondary schools. The literature reviewed alludes to a relational epistemology that is incumbent for SKAV development if education is to be used for human resource development. The researcher traces the practice with regard to

SKAV of the Mathematics policy document across the DoE, primary and secondary schools.

2.3.1 Department of education node

The DoE node is involved in the policy formulation and implementation of CAPS. With the introduction of CAPS, every subject in each grade was given a single, comprehensive and concise policy document that provided details on what teachers need to teach and assess for every subject. The National Department of Basic Education (DBE) had decided to implement CAPS in a phased approach over a three-year period, namely the foundation, primary and secondary phases. Teachers in the three phases attended workshops arranged by the DBE in every province in SA for the purpose of enhancing capacity for the implementation of CAPS. In South Africa, mediation of policy is the professional development offered by the DoE to practicing teachers to implement new policies. It is thus a mechanism to facilitate diffusion of curriculum policy change from its formulation to its implementation, and is conducted by superintendents of education management (SEMs) in each district who are employed by the DoE to give principals a general overview about CAPS.

Facilitators who have been teaching these subjects conduct orientation programmes with all teachers in their respective subjects. These facilitators are selected by the DoE and, like all other jobs; these vacancies are filled according to the demography of SA. The appointment of subject advisors and facilitators could be based on their political alliances or on affirmative action. Affirmative action is a way of making the workplace more representative and fair. It makes sure that qualified people from designated groups have equal opportunities in the workplace and in South Africa, these groups including black, coloured and Indian people, women and people with disabilities (Department of Labour 2000: 3). It also states that historically, these groups have been under-represented in many key work areas. The facilitators who orientate all teachers were initially teaching Mathematics at some time in their profession and they were oriented first by the Mathematics subject advisors. This is how CAPS in Mathematics was cascaded to all Mathematics teachers. Consequently it may be maintained that if the facilitators were not familiar with CAPS document in Mathematics, this would have a negative impact on the learners' understanding and performance in Mathematics. Hence, interface and refraction allowed the researcher to trace the emergent effect of the CAPS Mathematics Policy as it traverses from one medium to another, from the DoE to primary and secondary phases. Thus, mediation forms the vital link between policy formulation and policy implementation as this inadvertently impacts on the learners' understanding and performance in Mathematics.

2.3.2 Primary school node

At the primary schools node, Mathematics teachers are involved in the implementation of Mathematics CAPS Policy. This involves teachers familiarizing learners with the curricula content of the policy and monitoring learners' progress in respect of SKAV development in Mathematics. Teachers may be expected to teach other learning areas, depending on their school's post-provisioning norm (PPN) and at most primary schools the number of learners does not warrant teachers specializing in Mathematics (DoE 2011: 3). Not all of the Mathematics teachers in the Mafukuzela Gandhi Circuit have a tertiary qualification in Mathematics. Slavin, Lake and Groff (2009: 841) state that in order to ensure that learners have positive experiences with Mathematics education, they need to get it from teachers that are qualified to provide quality education. The UK Government increased the number of specialist teachers at primary level to ensure that all children have the best start in Mathematics at primary schools (Spaull and Kotze 2015: 14). Fadzil and Saat (2014: 213) argue that there is a significant shortage of Mathematics specialists in primary schools and there is an urgent need to find an effective way to train and employ primary teachers with specialist knowledge in Mathematics, as well as the confidence to teach. A study by Noll (2009: 1) in the USA reports that most learners believe that Mathematics is difficult and incomprehensible as learners fear that which they do not know, or with which they had scary experiences in the past. Noll (2009: 1) argues that the real challenge is how to motivate students to want to study and learn Mathematics in a stimulating and understandable manner. Mundia (2010: 156) emphasized that many currently serving Brunei teachers who are ineligible to take the MTeach course may need various forms of in-service training to update and upgrade their subject knowledge and teaching skills to the level demanded by ongoing educational reforms.

2.3.3 Secondary school node

The secondary school node of this study engages in the practice of mediation of secondary school learning of Mathematics, with the SKAV needed for learners to function effectively in this phase. In the secondary schools node, Mathematics teachers are involved in the implementation of the Mathematics CAPS Policy. It also involves teachers familiarizing learners with the curricula content of the policy and monitoring learners' progress in respect of SKAV development in Mathematics. Learners enter secondary schools directly after completing primary schooling. Consequently, if they had problems in Mathematics in the primary phase, it gets compounded in the secondary phase. Not all the secondary school Mathematics teachers in this study from the Mafukuzela Gandhi Circuit have a tertiary qualification in Mathematics. Some of them have engaged in the teaching of Mathematics prior to the implementation of CAPS. Clewes (2003: 2) states that the process of teaching and learning is central to learners' evaluation of service quality but teaching can be criticized for its lack of inclusion of teaching and learning outcome dimensions. Buttle (2013: 21) makes a similar criticism for predominantly measuring the process of delivery in the form of tests and examinations and not the outcomes of the service. In addition, both the service-quality and educational-quality appear to underplay the importance of service outcomes.

The problems encountered by learners may not necessarily be overcome because secondary school educators have the CAPS curriculum and assessments to complete. The DBE has taken subject advisers for the various phases in Mathematics from every district across South Africa for the orientation programme in CAPS. These advisors then went on to orientate facilitators who in turn workshopped teachers on the content, assessment, teaching methodology, resources and management of classrooms in CAPS in their respective districts. Hence, CAPS may have got diluted in the process of dissemination and it becomes problematic to ensure that the same policies and materials are used at every school in SA when all schools do not enjoy the same resources. Some learners who experienced problems in Mathematics will continue enduring problems in Mathematics, which will escalate.

2.4 Transition from primary to secondary school

School transition is a process of moving from the familiar to the unknown environment, which is experienced by every learner in his or her educational journey Noll (2009: 3). The transition is an on-going process that requires time and effort for learners to adjust to. Transition refers to the moving process at the end of grade 7 in primary school to grade 8 in secondary school. These new environments require students to make choices in academic and extracurricular activities as well as face increased academic and social demands. Learners' academic performance declines after the transition into high school and they receive less social support upon transition (Fadzil and Saat 2014: 211). McIntosh, Flannery, Sugai, Braun and Cochrane (2008: 27) state that there is an "increased risk factor in the transition from primary to high school", as their study tracked discipline and academic records for learners receiving general education services as learners transitioned schools.

A study by Paul (2014: 209) investigated learners' experiences on five strands when they transitioned from primary to secondary school: adaptation, pedagogy, curriculum content, achievement and school intervention structures. Paul (2014: 210) concluded that learners indicated that it took time to adapt to the secondary school Mathematics curriculum and most of them experienced difficulties in coping. He further stated that teachers should strive to work on building positive academic relationships with learners, as well as a positive pedagogical relationship which included a strong knowledge of how learners learn and a strong content knowledge. Fadzil and Saat (2014: 215) revealed that during early transition the learners developed a gap in relating to the level of the curriculum in Mathematics they had learned in primary school. Fadzil and Saat (2014: 216) also claimed that there is an issue of backwardness or gaps in the transition process from primary to secondary school. Rammala (2009: 89) also noted that long-lasting under-achievement in some South African schools is attributed to the nature of teaching and learning during the transition years. Paul (2014: 213) also concurred that learners experience major challenges during the transition from primary to secondary school with special regard to Mathematics learning as it takes time to adapt to the secondary school Mathematics curriculum. Interest and liking for Mathematics decreases during this transition. The transition requires learners to make adjustments in the various subject requirements and expectations of their subject teachers, while managing multiple homework and other demands. Tilleczek (2007: 67) stated that the increase in content depth and adaptations to new pedagogies present challenges that may lead to achievement loss. The transition period is therefore characterized by the development of negative attitudes towards Mathematics. Learners' performance scores tend to show a declining trend on transfer to secondary school. Kay and Knaack (2008: 273) emphasize that the transition into secondary school is marked by increased disengagement and declining motivation amongst learners, which in turn predicts subsequent school failure and dropout. This transition phase also coincides with the time when learners are experiencing the physiological, psychological and social changes associated with adolescence. Another common feature that characterizes the transition period is mathematical anxiety. Previous research has concurred that learners making the transition from primary to secondary school have substantial anxieties about the changes in Mathematics (Moodley 2011: 50; Zeedyk, Gallacher, Henderson, Hope, Husband and Lindsay 2003: 241).

Research conducted in the United Kingdom by Slavin et al. (2009: 841) suggests that primary schools are failing to develop learners' mathematical knowledge and skills sufficiently between the ages of seven and eleven. Quality is a problem from primary schooling through to higher education (McIntosh *et al.* 2008: 251). Low scores in Mathematics is a major concern as learners are not able to meet the challenges in secondary schools and tertiary institutions to pursue careers in Mathematics, Science and Technology. Reddy *et al.* (2015: 23) emphasize that a lack of prerequisite knowledge amongst learners had a serious effect on learner achievement. A lack of prerequisite skills from the previous lower grades seems to be the most important factor limiting academic performance. A solid foundation is paramount in Mathematics education and one of the priorities is to improve learner performance, particularly in primary schools. Reddy *et al.* (2015: 5) state that three-quarters of South African learners had not acquired even the minimum set of mathematical skills by Grade 9 and these learners are stuck at the shallow end of skills acquisition. The acquisition of skills in Mathematics is cumulative. Spaull and Kotze (2015: 13) state that learners that have acquired learning deficits early on in their schooling careers and these backlogs are the root cause of underperformance in later years. They argue that any attempts to raise learners' mathematical proficiency must first address these deficits if they are to be successful. Reddy *et al.* (2015: 5) argue that emphasis needs to be placed on improving the fundamentals of instruction in earlier grades in order to reduce the large number of learners who lack a basic knowledge of Mathematics in grades 8 and 9. This becomes a major problem as learners are unable to cope with Mathematics in the secondary phase. The researcher has thus focused on the quality of the current state of Mathematics at the microlevel from primary school to high school.

2.5 Necessities for quality education

Providing learners with quality education, quality teaching and excellent learning experiences are important for learner achievement. In an effort to nurture learners and foster creativity, it is essential that efforts must be made to eliminate negativity in Mathematics and teachers should assist learners in guided discovery to arrive at solutions. It is therefore imperative to understand that Mathematics education is a complex system embedded in diverse facets of learning, as indicated in Figure 2.3.

Figure 2.3: Five points of quality education

Source: Unicef (2014: 11)

The United Nations Children's Fund (UNICEF 2014: 7) states that quality education must include the following:

❖ **Learning environments** that are healthy; safe; protective; and gender-sensitive and that provide adequate resources and facilities. Physical learning environments are the places in which formal learning occurs. They may range from relatively modern and well-equipped buildings to open-air gathering places. The quality of school facilities seems to have an indirect effect on learning. In Latin America, a study that included 50 000 learners in grades three and four found that children whose schools lacked classroom materials and had an inadequate library were significantly more likely to show lower test scores and higher grade repetition than those whose schools were well equipped (UNICEF 2014: 8). Other studies carried out in Botswana, Nigeria and Papua New Guinea concur with these findings (Pennycuick 2013: 61). Children from language minorities, politically or geographically disadvantaged groups and groups at low socio-economic levels may also endure disadvantages which may hinder the advancement of quality education. Restructuring of poor learning environments needs to occur to improve learning opportunities for children of all abilities and backgrounds.

❖ **Content** that is reflected in relevant curricula and materials for the acquisition of basic skills, especially in the areas of literacy, numeracy and skills for life. Quality content also refers to the intended and taught curriculum of schools. National goals for education and outcome statements that translate those goals into measurable objectives should provide the starting point for the development and implementation of curriculum (UNICEF 2014: 8). Content should emphasize deep rather than broad coverage of important areas of knowledge; authentic and contextualized problems of study; and problem-solving that stresses skills development as well as knowledge acquisition. Curriculum should also provide for individual differences; closely coordinate and selectively integrate subject matter; and focus on results or standards and targets for student learning (Glatthorn and Jailall 2012: 32). The learning context and agendas people have for learning to read and write have an important impact on the development of literacy skills (UNICEF 2014: 9). Attention to the way literacy is developed is critical since research has shown that language learning cannot be separated from content. The curriculum structure should be gender-sensitive and inclusive of children with diverse abilities and backgrounds, as well as be responsive to emerging issues such as HIV/AIDS and conflict resolution.

❖ **Processes** through which trained teachers use teaching approaches in well-managed classrooms and schools and skillful assessment to facilitate learning. The preparation that teachers receive before beginning their work in the classroom, however, varies significantly from what is practiced in the classroom. As a consequence of too little preparation before entering the profession, a number of teachers in China, Guinea, India and Mexico were observed to master neither the subject matter they taught nor the pedagogical skills required for good presentation of the material (Carron and Chau 2009: 14). This affects educational quality since student achievement, especially beyond basic skills, depends largely on teachers' command of subject matter (Mullens, Murnance and Willett 2011: 139) and their ability to use that knowledge to help students learn. Professional development can help overcome shortcomings that may have been part of teachers' pre-service education or curriculum changes and keep teachers abreast of new knowledge and practices in the field. Teachers' working conditions affect their ability to provide quality education. Effective teachers are highly committed and care about their learners (Craig, Kraft, and du Plessis 2008: 21). Consequently, they need supportive working conditions to maintain these positive attitudes.

❖ **Learners** who are healthy; well-nourished and ready to participate and learn; and are supported in learning by their families and communities. Physically and psychosocially healthy children learn well. Healthy development in early childhood, especially during the first three years of life, plays an important role in providing the basis for a healthy life and a successful formal school experience (McCain and Mustard 1999: 21). Evidence from the Philippines, Sri Lanka and Turkey has shown that children who participate in early intervention programmes do better in primary school than those who do not benefit from formal early child programmes. Furthermore, and studies from India, Morocco and Latin America demonstrate that disadvantaged children benefit the most from such programmes (UNICEF 2014: 5). A child who misses positive stimulation or is subject to chronic stress in the pre-school years may have difficulty with psychosocial development later in life (McCain and Mustard 1999: 25). Parents may not always have the tools to support their children's development throughout their school years. Parents' levels of education, for example, have a multifaceted impact on children's ability to learn at school. Parents with little formal education may also be less familiar with the curriculum taught at school, thereby limiting their ability to support their children in learning. The effects of schools in poor areas can often outweigh the impact of family background and practices (Carron and Chau 2009: 17). Healthy children with positive early learning experiences and supportive, involved parents are thus most likely to succeed in school.

❖ **Outcomes** that encompass knowledge, skills and attitudes and are that linked to national goals for education and positive participation in society. Parents tend to see academic achievement as closely related to the opportunity for social promotion and employment. These anticipated outcomes tend to be highly valued by families. Future employment possibilities that result from education seem to be a primary factor in the demand for primary education (Glatthorn and Jailall 2012: 31). Quality learner outcomes are the expected effects of the educational system. They include what children know and can do, as well as the attitudes and expectations they have for themselves and their societies. A project in Ghana has demonstrated that ongoing assessment of student performance can provide teachers with the information they need to improve student learning. The philosophical basis of the project was to identify what skills each student possesses and to use instruction to progressively build on this foundation (Harris 2010: 16). Academic achievement is often used as an indicator of school quality because it is easily measurable using standardized tests and examinations. Schools should strive for quality outcomes by bringing together elements of quality education to improve Mathematics education.

2.6 Quality assurance in education

"Quality assurance" is a term that is new in education but one that has rapidly become very important. According to Allais (2008: 1) from the Centre for Education Policy Development (CEPD), quality assurance has its roots in large-scale manufacturing. "Quality assurance" is imperative in preventing defects from occurring, instead of only checking up on finished products. Teachers should be assisted and oriented in implementing the new CAPS document so that challenges could be obviated. Using the knowledge of engineers as well as people who started to develop expertise in quality management, systems and processes were developed to check on quality at all stages of production (Allais 2008: 21). It is also imperative that quality teaching and learning takes place in every stage of schooling to eradicate a growing problem in Mathematics education.

There is no more important resource to a country's education system than well-qualified and well-motivated teachers. Motivated and competent teachers will result in excellent teaching. The Council of Australian Governments (COAG 2014: 4) emphasises that it is well established that teacher quality is the single greatest in-school influence on student engagement and results. In addition, evidence indicates that improving the quality of the teaching workforce is fundamental to any overall improvements in schooling. The impact of teaching is cumulative, a poor-quality teacher not only imparts less knowledge for the period they teach the student, but can leave the student worse off when they later attempt higher level work. The issue of language policy and practice is complex when the majority of learners are taught in a language that is not their home language. Mustafa (2013: 32) argues that it is difficult for teachers to have the education, experience, knowledge and skills to facilitate effective classroom practices in such an environment. The language issue is further complicated by the fact that there is substantial language fluidity. According to (Glatthorn and Jailall 2012: 32), professionalism provides an overview of the qualities of execution and implementation of the process of teaching. The implementation process involves the quality of teachers to perform their duties to attract learners and to produce good results.

Schools that perform well focus on improving instruction because of its direct impact upon student achievement. Comparisons provide varying insights into Mathematics education across the globe, whether it is in North America, Europe, Japan or India. Some education systems demonstrate that excellent education is attainable. They also show that the challenge of achieving a high and socially equitable distribution of learning outcomes can be successfully addressed and that excellence can be achieved consistently throughout the education system. The McKinsey Report (UNESCO 2012: 5) suggested that three things matter most in education, namely:

- Getting the right people to become teachers;
- Developing them into effective instructors; and
- Ensuring that the system delivers the best possible instruction for every child.

In taking cognizance of the above three aspects, changes and improvements are required at various levels in the education system, ranging from funding structures to governance and incentives. These systems all ensure the necessary foundational conditions such as rigorous standards and assessments; clear expectations and differentiated support for teachers and learners; and sufficient funding, facilities and other core resources. Educational mobility for learners will be a real problem unless there is quality education with selective quality assurance measures. Quality assurance in education helps to support teachers and build expertise and capacity in the education system to deliver positive outcomes for students. According to the Australian Government (2012: 3), education and training play an important role in increasing the productive capacity of the economy, allowing higher levels of economic growth without creating inflationary pressures. The quality of a school system rests on the quality of its teachers. The evidence suggests that getting the right people to become teachers, is critical to high performance. UNESCO (2012: 4) explicitly emphasizes the importance of getting good people into teaching: "The quality of an education system cannot exceed the quality of its teachers". A study by Haycock and Crawford (2006: 2) in Los Angeles showed that learners taught by teachers in the top quartile of effectiveness advance, on average, an approximate five percentile points each year relative to their peers; whereas those taught by teachers in the bottom quartile of effectiveness lose, on average, five percentile points relative to their peers. These effects are cumulative. Their study also suggested that if all black students were assigned to four highly effective teachers, it would be sufficient to close the average black-white achievement gap. Through sharing; understanding; and applying standards and expectations, quality assurance helps to raise standards and expectations and levels of consistency across teachers and schools. Haycock and Crawford (2006: 1) state that Singapore and South Korea's general public believe that teachers make a greater contribution to society than any other profession. UNESCO (2012: 1) emphasizes that once teaching becomes a high-status profession, more talented people became teachers, thereby lifting the status of the profession even higher. They further state that this is

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particularly apparent in Finland and South Korea, where historically strong teaching forces have given the profession a high status in the eyes of the general public, attracting further high-calibre recruits and perpetuating this status. Conversely, where the profession has a low status, it attracts less-talented applicants and the status of the profession goes down further and, with it, the calibre of teachers it attracts. Quality assurance in education is part of the day-to-day work of teachers in primary and secondary schools and is integral to learning. It also serves to ensure that high standards are maintained and outcomes improved for students. Quality assurance emphasizes the importance of planning, engaging and exciting learning experiences that will focus on achieving the standards and expectations defined through the outcomes.

Quality assurance is the process that ensures products and services meet government requirements. Continuing professional teacher development (CPTD) assists teachers to grow their knowledge and skills throughout their careers. CPTD is the means by which quality assurance at schools can be brought about, which ranges from developing personal knowledge about a new subject responsibility to the pedagogic and assessment skills needed to get more from their learners and the teacher is constantly faced with the challenge of how to improve their practice (UNESCO 2012:17). Thus, the ongoing development of the teacher is a key influence on teaching quality. CPTD provides opportunities for teachers to develop professionally once they have qualified. Some countries may have available CPTD programmes linked to Higher Education Institutions (HEI) or initial teaching education (ITE) institutions, while others may have provision for in-service training provided by education providers. Ideally, national CPTD programmes need to be structured in such a way that they allow a continuum of professional learning to take place in a progressive way (UNESCO 2012: 18). The main emphasis of the strategy is on supporting teachers for quality learning. Based on previous experiences and on the application of the Teacher Training Initiative for Sub-Saharan Africa and other UNESCO teacher-related programmes, UNESCO (2012: 18) has identified three strategic priorities with associated themes. These are:

❖ **Teacher shortage** - bridge the teacher gap in priority countries, particularly in Sub -Saharan Africa;

- ❖ **Teacher Quality** - teaching quality needs to improve; and
- ❖ **Knowledge** - productivity and communication via various departments in education is essential.

Continuous development programmes for Mathematics teachers should be mandatory to improve teaching and learning and to improve the status quo of the subject, which has the highest failure rate. High-quality teaching is critical to improving the future lives of individuals. It brings with it a range of economic, social and intergenerational benefits.

It is imperative to note that from the researcher's experience as an educator who taught at eleven different schools in KwaZulu-Natal, schools with high levels of parent and community involvement achieve improved learning, attendance and behaviour. Family and community involvement in schools is therefore central to high quality education. Van Voorhis (2013: 2) states that emphasis is being placed on the importance of parent involvement in children's education. His studies reveal that parents involved in their child's homework results in higher rates of homework completion; fewer homework problems; and improved academic performance amongst elementary and secondary school children. Putnam (2015: 21) of Harvard University has demonstrated the importance of parental involvement and referred to it as the 'glue' that holds society together, reflecting the richness of the connections between school and the extent to which they share norms of trust and cooperation. Putnam (2015: 23) further states that these elements come together at schools that focus on the wider needs of learners, within and beyond the school, to support their wellbeing, learning engagement and academic achievement; schools that not only commit to excellence in teaching and learning within the classroom, but are prepared to address the range of external factors that impact on learners' ability to engage in learning. Twenty studies conducted at schools in Michigan by Patall, Cooper and Robinson (2014: 3) indicate that correlating parent involvement and achievement-related outcomes reveals a positive associations for elementary school and high school students but a negative association for middle-school students; (b) a stronger association for parent rule-setting compared with other involvement strategies; and (c) a negative association for Mathematics achievement but a positive association for verbal achievement outcomes. The United Kingdom offers extended school programmes that support parental development at schools which provide a comprehensive range of services that include access to health services, adult learning and community activities, as well as study support and childcare. Van Damme (2015: 3) head of the Innovation and Measuring Progress Division at the Directorate for Education and Skills, Centre for Educational Research and Innovation (OECD) in Paris, highlighted the growing positive impact of education on various social outcomes. He also noted that parents with higher levels of education are more likely to contribute to the well being of their children at school.

The national evaluation conducted in the United Kingdom found positive impacts on the attainment of learners at schools that provided full-service extended benefits for families and local people. Such positive effects are also found in local communities as a whole. Van Damme (2015:2) concurred that national evaluation also showed that bringing together different strands of extended service provision into a coherent whole leads to outcomes over and above what the individual activities might have generated in isolation. Putnam (2015: 17) also recognized that social interaction and trust are very important to schooling. When social connections and trust are high, schools can rely on strong social support in pursuit of their goals. The Council of Australian Governments (COAG 2014: 5) states that school attainment is positively linked to higher levels of employment and labour force. A reform agenda was proposed to deliver changes in three core areas, namely:

1. Raising the quality of teaching at schools;
2. Ensuring all learners are benefitting from schooling by building strategies based on high expectations of attainment, engagement and transitions for every student, especially in disadvantaged school communities; and
3. Improving transparency and accountability of schools and school systems at all levels (COAG 2014: 5).

Van Damme (2015: 23) review on evaluation and assessment frameworks for improving school outcomes, launched in late 2009, was designed to respond to the strong interest in evaluation and assessment issues evident at national and international levels in countries in Europe. It also provided a description of design, implementation and use of assessment and evaluation procedures in countries to analyze strengths and weaknesses of different approaches and provide recommendations for improvement that enhances the learning outcomes in students.

2.7 Quality Assurance

"Quality assurance" is a term that is relatively new in education but has rapidly become very important. According to Allais (2014: 27) from the Centre for Education Policy Development (CEPD) quality assurance has its roots in large-scale manufacturing. "Quality assurance" arose out of attempts to prevent defects from occurring, instead of only checking up on finished products. The South African Government has emphasized the priority that quality education is a key focus area between 2012 and 2014. The purpose of the Department's Strategic Plan outlines the objectives and elaborates on how the DoE seeks to improve the quality of education (DBE 2011: 17). The Strategic Plan reflects the government's commitment to undertake activities effectively and timeously to produce the outputs that will in turn contribute to the achievement of an improved quality of basic education.

The United Nations Educational, Scientific and Cultural Organization (UNESCO 2012: 31) advocates two goals for quality Mathematics education, namely to overcome the shortage of qualified Mathematics teachers and to ensure access to basic education. Previous research in the United Kingdom by Slavin, Lake and Groff (2009: 908) suggests that primary schools are failing to develop pupils' Mathematical knowledge and skills sufficiently between the ages of seven and eleven. According to Zimmerman (2006: 241) and Jurasaite-Harbison and Rex (2010: 273), both novices and veteran teachers are resisting change and teachers are often constrained from using their newly acquired knowledge and skills to benefit learners. To the best of the researcher's knowledge, no studies have been conducted on the quality interface between primary and secondary Mathematics education to determine the preparation of learners for the secondary phase in SA. This study will address this gap between primary school and secondary school Mathematics education.

2.8 Quality assurance and evaluation

Quality has emerged as a necessity in education in the face of increasing competition and a demand for better quality products and services. Cheng (2003: 204) focuses on the effectiveness of internal education processes, particularly teaching and learning. Cheng (2003: 205) explains that quality in education refers mainly to the achievement of planned education goals, particularly in terms of student outcomes, and that the higher achievement in planned education goals implies better quality in education. Reynolds, Lawrence, Thorton and Smith (2013: 5) emphasize that learners' academic performance is influenced by the quality of education or instruction that they receive.

The quality of education in SA seems to be in a downward spiral, gauging from the results in Mathematics in ANA for Grade 9 and the NSC for Grade 12 as discussed in chapter 1. The World Economic Forum has placed SA last amongst 62 countries on the quality of Mathematics and Science Education in their annual report in 2012. The Chairman of the Marang Centre for Mathematics and Science Education at the University of Witwatersrand, Professor Rollnick (2013: 1), outlined two problems regarding the quality of Mathematics education, namely learners are not taught to understand and apply Mathematics and teachers do not have the knowledge to teach Mathematics, which impacts on the standard of teaching. The Trend in International Mathematics and Science Study (TIMSS) Report suggests that South African learners have difficulty grasping key mathematical concepts and 90% do not possess a basic mathematical knowledge (Reddy 2006: 3). The South African Chamber of Commerce and Industry's (SACCI) CEO, Rau (2013: 1), stated that their organization remained concerned about the quality of the matric certificate owing to the relatively low pass requirements. For a learner to pass matric, he or she had to achieve a minimum of 30 % in the seven subjects. Rau (2013: 2) further argues that the matric certificate should be a fundamental signal into the labour market that a school-leaver could perform at least a low-skilled position. However, this is no longer the case given a growing body of evidence of ill-equipped school leavers. This distressing state of affairs in the labour sector is a reflection on the present state of education and has given rise to the need to formulate a new approach, one which emphasizes quality in education. It is important to determine what knowledge is required and what the profession contributes to knowledge individually and collectively. Researchers (Jerald, Levy and Murnane 2009: 54) have found that students taking higher-level Mathematics courses develop better Mathematics skills that lead to greater success in both teaching and the labour market.

There are two quality assurance organizations in SA, which operate directly under the Minister of Education. The first is Umalusi, which monitors quality in general and further education and training. The second is the Higher Education Quality Committee (HEQC), which monitors quality in higher education in SA and Umalusi reports directly to the Minister of Education. Umalusi comes from the Nguni word, meaning shepherd or guardian of the family belongings resources, and valuables. Therefore, Umalusi in the context of quality assurance in education means to take care or shepherd the nation's valuable assets of knowledge, which comes from education and training. As guardian of the nation, Umalusi endeavours to support and further education and training as the guardian is expected to do for a family (DoE 2013: 5). It also endeavours to be strict to ensure that training providers comply with the guidelines provided and keep the high standard of GET and FET training.

Quality assurance authorities such as Umalusi ensure that the qualifications obtained in South Africa will be recognized anywhere in the country and that the qualifications are also recognized by international institutions. Umalusi was created to monitor and improve the quality of general and further education and training in SA. Umalusi uses both traditional methods of monitoring quality in education and more modern quality assurance methods, (DoE 2013: 7). The DoE (2013: 9) outlines three main ways in which Umalusi ensures quality assurance in education, namely:

❖ It monitors and moderates students, through external examinations.

❖ It evaluates whether providers of education and training have the capacity to deliver and assess qualifications and learning programmes, and are doing so to expected standards of quality. Umalusi also accredits assessment bodies to evaluate students.

❖ It evaluates the quality of qualifications.

The South African Government has prioritized and emphazised quality education as a key focus between 2012 and 2014 (DoE 2012: 3). This Strategic Plan reflects the commitment of the DoE to undertaking activities effectively and on time, and to produce the agreed-upon outputs that will in turn contribute to achieving an improved quality of basic education. The condition of infrastructure, availability of textbooks, learning materials and class sizes all influence the teacher's experience as an educator. The quality of administrative support and leadership is another critical element in school processes, both for students and for teachers. At the macro level, ensuring financial resources for education, especially for recurrent school budgets is a necessity. Van Damme (2015: 1) emphasizes that teachers need governments that are supportive of the education system and that by having clear expectations of the knowledge and skills, learners will need to succeed at secondary schools and tertiary institutions or the job market. The Minister of Basic Education in SA, Angelina Motshekga (DoE 2012: 2) states that poor quality and outdated training for Mathematics teachers has escalated the problem and that further development and training for quality teaching in Mathematics is necessary. The United Nations Educational, Scientific and Cultural Organization (UNESCO 2012: 14) advocates two goals for quality Mathematics education, namely: to overcome the shortage of qualified Mathematics teachers; and to ensure access to basic education. Professional development can help overcome shortcomings that may have been part of teachers' pre-service education and keep teachers abreast of new knowledge and practices in their field. This ongoing training for teachers can influence student achievement and impact on quality in education.

Quality teaching cements quality assurance in learners and the school as a whole. A culture of high expectations needs to be established at schools for students and teachers. The culture of teaching and learning must also be matched to effective transparency and accountability mechanisms that meet the needs of parents, policy makers and the broader community. Teachers and other role players need to continue to work collaboratively to develop approaches in quality assurance by building on the existing strengths of current practice in order to improve the status quo in Mathematics. Quality assurance at schools includes monitoring, evaluation and planning for improvement. The following are strategies of assessing teachers at all DoE schools throughout SA in order to establish a positive repertoire in the teaching and learning environment (DoE 2012: 5):

2.8.1 Whole-school evaluation (WSE)

The core role function of the Department of Education is to deliver quality education in all institutions. To realize this objective, proper planning, implementation, monitoring, evaluation and reporting are key to the DoE. The DoE have implemented activities so that quality teaching and learning takes place and all learners will ultimately become productive members in society (DoE, 2012: 2).

2.8.2 Internal whole-school evaluation (IWSE)

The National Policy on Whole-School Evaluation introduces an effective monitoring and evaluation process that is vital to the improvement of quality and standards of performance in schools. The IWSE is radically different from the previous school inspection system conducted in SA under the apartheid regime. The purpose of IWSE is to evaluate the overall effectiveness of a school, as well as the quality of teaching and learning.

2.8.3 Integrated quality management system (IQMS)

IQMS is a tool that is used to monitor an institution's overall effectiveness and to evaluate an educator's performance. Individual educators conduct self-evaluation. An educator is evaluated on every performance standard that is applicable to his or her post level. Evaluation is not based on qualification and self-improvement of the individual.

2.8.4 Performance management and development system (PMDS)

The PMDS is a system to manage and develop the performance of public service employees with a view to achieving both individual and institutional excellence. The main objectives of the PMDS are to improve performance, thereby developing a culture of quality; and to identify areas for development and formulate a plan to ensure that this development takes place.

2.8.5 School improvement planning (SIP)

School improvement plans (SIPs) are mandated by the government for schools officially designated as ‘in need of improvement.’ SIP should include strategies for improving learner performance in the targeted goal areas; measure performance through multiple assessments; and describe how and when improvements will be implemented. The School Improvement Plan (SIP) is developed and submitted to the district which is sent to schools.

2.8.6 School Development Planning (SDP)

Principals produce, after consultation with internal and external stakeholders, a three-year school development plan based on the school’s strengths, weaknesses, opportunities and threats (SWOT analysis). This is the starting point for any financial planning in a school. The SDP details targets; priorities; budget; responsibilities; implementation time-frames and strategies for reporting; risk management; monitoring; and evaluation.

2.8.7 Academic performance improvement planning

Learning at schools will not improve markedly unless teachers are given the opportunity and support they need to advance by increasing the effectiveness of the methods they use.

2.8.8 External whole-school evaluation (EWSE)

The National Policy on EWSE is being introduced. This complements other quality assurance initiatives conducted under systemic evaluation, namely: accreditation of providers; programme and service reviews; and monitoring learning achievements. This Policy is aimed at improving the overall quality of education at South African schools.

One of the most important aspects of the South African Schools Act (No 84 of 1996) is the law relating to school governing bodies. At the heart of this is the idea of a partnership between all people with an interest in education. Schools will be improved only through the joint efforts of parents, educators, learners, members of their local communities and various education departments. The DoE assists institutions in understanding the roles and responsibilities of the different stakeholders in ensuring the general functionality of the school and quality curriculum delivery. The primary purpose of evaluation is gaining insight into prior or existing initiatives, to enable reflection and assist in the identification of future change. The main purpose of evaluation can be “to determine the quality of a curriculum by formulating a judgment” (Hurteau, Houle and Mongiat 2009: 308). The authors also state that the DoE forges strong links with schools and provide better opportunities to share good practice and build supportive networks. Harnessing the collective effort of the wider schools spectrum has the potential to bring greater coherence and an integrated approach to the national effort to improve learning experiences and outcomes in Mathematics. The DoE should incorporate incentive-based evaluation that has already been adopted in other progressive countries.

2.9 Student quality

Learners’ school, home and community environments shape their education and learning. Societal change and related societal problems impact on the youth of a post-apartheid South Africa. Within the parameters of such major issues, it can be argued that adolescents’ education could be negatively influenced by the extent of societal problems that are currently experienced in South Africa. Amidst severe problems such as poverty, unemployment, HIV/AIDS and violent crimes, learners contend with added burdens.

Steyn, Badenhorst and Kamper (2010: 171) stated the distressing fact that 40% of South Africa's population lives in acute poverty conditions; less than 30% of the employable poor are working; 72% of the country's poor live in rural areas. They further concluded that HIV/AIDS was singled out as South Africa's biggest problem and that poverty and unemployment; violent crime; violence; gansterism; and abuse of women and children were serious societal problems. Numerous learners come from child-headed households as a consequence of such major problems. Learners are faced with many challenges and these socio-economic problems affects learning in classrooms. The curriculum does not address such challenges and this impacts on the teachers who liaise with these learners. Steyn *et al’s*. (2010: 177) findings indicate that a new, non-racial generation is emerging, but they also highlight a formidable ethical dilemma, which is societal factors and an ailing education system that are blocking the future ideals of thousands of South African adolescents. A recent study on school violence conducted by the Centre for Justice and Crime Prevention (CJCP 2015: 1) shows that 15.3% of children at primary and secondary schools have experienced some form of violence while at school, most commonly threats of violence, assault and robbery. They further emphasized that the experiences of learners indicated that more than four-fifths reported incidents of physical violence perpetrated by learners on fellow learners in their school in the preceding year. These learners face significantly greater challenges than their counterparts in countries where society is more stable (Steyn *et al.* 2010).

The extent of such challenges is reported on an almost daily basis in the media. Poverty, unemployment, HIV/AIDS and violent crimes are societal problems which learners face across racial boundaries in SA in varying degrees. There is growing evidence at schools that learners' perceived that the lack of school safety adversely affects academic performance. Globally, there is evidence that bullying in schools is on the rise. Cyber bullying is bullying that takes place using electronic technology, which may include mean text messages or emails; rumors sent by email or posted on social networking sites; and embarrassing pictures, videos, websites or fake profiles (Hinduja and Patchin 2009: 21). Bullying has a negative impact on educational achievement. Hinduja and Patchin (2009: 24) state that such incidents of violence and bullying are detrimental to a child's attachment to school, leading to increased drop-out and truancy rates, low self-confidence and low levels of academic performance. These factors are also likely to impact on young people's later vulnerability to violence, as well as the likelihood of their own turning to violence as they grow older. Thus, there are many factors that affect student quality and students are not competent enough to meet the challenges of a changing curriculum in Mathematics. Teachers struggle with learners who experience challenges within the meso, exo and micro systems to complete the curriculum.

2.10 Teacher quality

It is well established that teacher quality is the single greatest in-school influence on student engagement and results. Furthermore, evidence indicates that improving the quality of the teaching workforce is fundamental to any overall improvements in schooling. The highest quality teachers, those most capable of helping their students learn, have deep mastery of both their subject matter and pedagogy (Darling-Hammond 2006: 303). The 2007 McKinsey Report, which identified features common to the world's top-performing school systems, argues that the quality of an education system simply cannot exceed the quality of its teachers and that the only way to improve outcomes is to improve instruction. According to the McKinsey Report (2007: 23), the best-performing systems also strive to get the right teachers to become principals; to develop their instructional leadership skills; and to focus their time on the core task of instructional leadership in the school. Research also demonstrates that one highly effective way to improve the quality of teaching is to increase the pool of potential teachers.

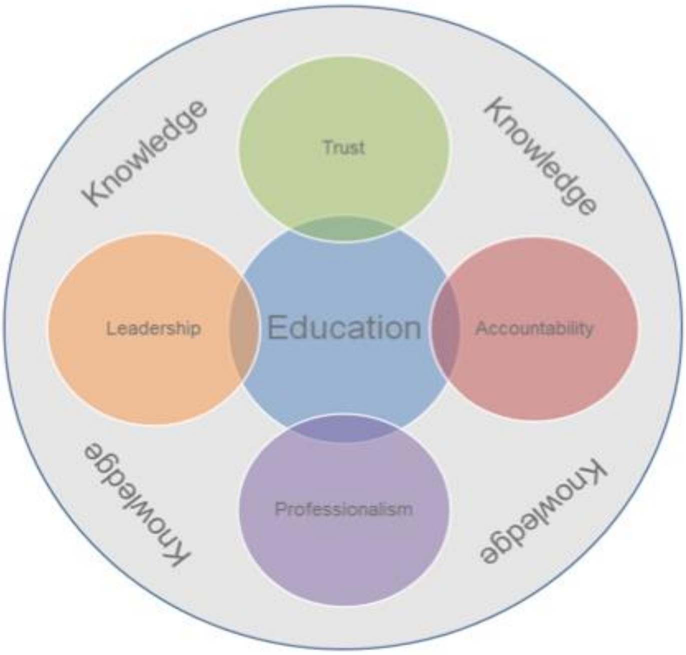
It is important that countries have systems in place to ensure that the training and development of teachers is of an appropriate quality as the quality assurance of teachers is an important attribute to the initial teaching qualification, depending on the provision. This may be through its own quality assurance systems (UNESCO 2012: 5). UNESCO (2012: 5) further advocates that acquiring an initial teaching qualification is not the end but the beginning of a professional journey for a teacher. Teachers need to be learners themselves, constantly striving for improvement to better their knowledge, their understanding and skills in order to improve strategies in teaching Mathematics.

Van Damme (2015: 17) states that Mathematics teachers need to have four main qualities namely: trust, accountability, professionalism and leadership which is surrounded by knowledge, especially how schools function as organizations and how systems could be better organized as illustrated in Figure 2.5. Knowledge surrounds all these themes. Trust is essential for establishing conditions conducive to effective and sustainable innovative change. Trust can facilitate open communication and interactions, enable stakeholders to be facilitators and reduce the need for control and monitoring. Effective strategies are essential for improving the performance of current teachers in ways that increase student learning and school achievement in Mathematics.

Teacher quality in Mathematics has the following five goals illustrated in Figure 2.5:

i **Professionalism**: Professionalism implies exploring the relations between practices of teachers and other instructional personnel; professional development and student outcomes in mathematics, as well as mediators and moderators of the relations between student outcomes for the purpose of identifying potential targets of intervention. Van Damme (2015: 3) argues that developing innovative programs and practices for teacher professional development are intended to improve teacher practices and, through them, student learning and achievement; developing and validating new assessments or validating existing assessments of teachers of mathematics.

Figure 2.4: Teacher quality



Source: Van Damme (2015: 1)

ii Accountability: The future of education lies in strong accountability with multiple stakeholders. According to Van Damme (2015: 4), accountability is important in Mathematics teaching as Mathematics educators must be able to demonstrate that students are learning and the required reporting of group data sheds light on gaps and problems within the Mathematics program.

iii Leadership: School leaders can most effectively raise attainment in their school. The most effective action they can take is to empower teachers to become learners, actively improving their own teaching rather than simply complying with rules about how to teach. Gu *et al.* (2014: 14) emphasize that school leaders could radically change the governance of education systems and processes of innovation which critically depend on leadership for change.

iv Trust: Pressure to succeed and to pass examinations makes it difficult for learners to be at ease with the Mathematics teacher and to develop a trust which is receptive to the idea that Mathematics can be enjoyable and need not generate anxiety and panic. Mwingirwa (2015: 189) states that pressure also makes it difficult for teachers of Mathematics at any level to aim at teaching for the enjoyment of learning and achieving effective teaching of Mathematics, rather than for future examination success.

v Knowledge: Van Damme (2015: 4) argues that teachers believe in being well prepared before going to teach. For example, if a teacher wants to use Information Communication Technologies (ICT) in teaching Mathematics but feels incompetent in the use of ICT, he/she will shy away from using it (Mwingirwa 2015: 189). This calls for preparation of teachers and sufficient knowledge to enable them to embrace the teaching of Mathematics.

Teacher quality is one of the most important variables for learner success (Angle and Moseley 2009: 479).

2.11 Characteristics of Mathematics teachers

There is a perceived stereotype of a hierarchy that exists in American school systems between the elementary and secondary levels of schools, with secondary being considered at a higher level (Coke 2005: 394 and Turner 2003: 491). Vala and Talwanga (2015: 145) state that the skill of teaching in primary school is acquired at secondary school where a specific curriculum is set for that purpose and becoming a teacher in secondary school implies attending a high pedagogical institute to train teachers. Students registered in these institutions for an academic discipline in

Mathematics are empowered with pedagogical knowledge and a strong emphasis on the teaching of the subject. Coke (2005: 396) argues that vertical co-operative learning is needed between elementary and secondary school teachers and while this would help with the transition between grades and subjects, it is incumbent upon school principals to implement these co-operative learning meetings. Mwingirwa (2015: 189) states that Mathematics is one of the core subjects in the secondary school curriculum in Kenya and students require a certain minimum grade in Mathematics before they are enrolled into any university course. She further suggests that Mathematics is in some way thought to be of special importance in the secondary school. A study by Book and Freeman (1986: 49) compared entry-level elementary and secondary education Mathematics teachers and found important differences in areas such as: academic background, career plans, prior experiences in teaching and in their expectations professionally. Book and Freeman (1986: 51) concluded that teachers who pursue secondary school Mathematics teaching have taken advanced courses in Mathematics at tertiary institutions; have more perceived confidence in their ability to be effective in teaching in that content knowledge; and are more likely to indicate their desire to transfer their love of the subject to their learners. A study by Potari (2014: 101) indicates that the USA is aiming to provide in-depth concentration on mathematical pedagogical content knowledge (PCK) for primary school teachers as it found that PCK of primary school teachers did not meet the benchmarks in teaching and learning strategy.

Collopy (2003: 291) concluded that a Mathematics teacher’s beliefs about Mathematics, learning and his or her role in teaching can vary greatly from teacher to teacher. Her case-study research showed that two teachers in the same elementary school, teaching the same content from the same textbook had very different teacher dispositions based on how they perceive Mathematics and their role in teaching the content. The study also provided evidence that teachers’ resources, both intellectual and concrete, and dispositions greatly impacted learner engagement in learning Mathematics. Collopy (2003: 288) found tremendous variation in the ways the teachers read, interpreted and used the teachers' guides. Darling–Hammond, (2006: 312) found that the formal preparation of the teacher, specifically subject-matter degree predicts higher students’ achievement and teachers’ cognitive and verbal ability and knowledge of subject matter are also important to students' achievement as teachers' completion of a formal degree in the subject matter and pedagogical knowledge in Mathematics. Whether a teacher uses traditional or more current methods of instruction, efficient use of teaching time has a significant impact on student learning. Teachers' knowledge in the classroom represents the starting point for students.

2.11.1 Knowledge of Mathematics teachers

Teachers' mathematical knowledge matters and significantly predicts gains in students' achievement (Ball, Hill and Bass 2008: 21). A lack of mathematical context knowledge can impede teachers' abilities to notice and analyze students' mathematical thinking (Putnam 2015: 24). Improved mathematical knowledge can also help teachers connect Mathematics to classroom practice as teachers analyze and use new curriculum materials. Professional development that focuses on improving teachers' mathematical knowledge can help them develop the confidence to teach mathematical topics that they previously avoided (Glatthorn and Jailall 2012: 31). Professional development is to help teachers develop the beliefs, habits and dispositions needed to improve practice on an ongoing basis.

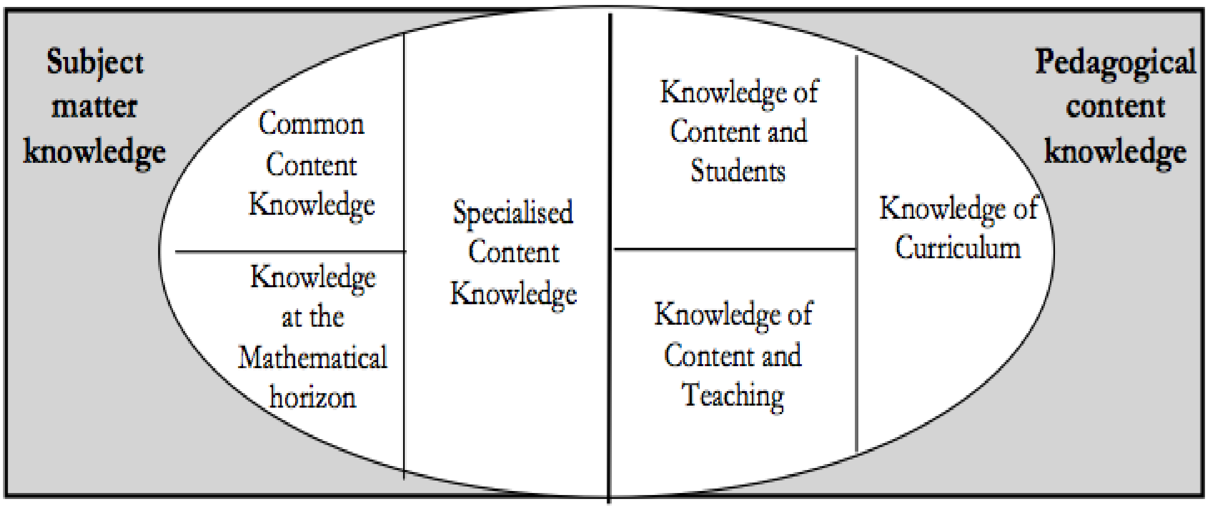
According to Van den Heuvel-Panhuizen (2012: 11), Freudenthal (1991) laid the foundations of Realistic Mathematics Education (RME) to address the world-wide need to reform the teaching and learning of Mathematics and to move away from mechanistic Mathematics education. RME is based upon the following five components:

- Using a real-world context as a starting point for learning;
- Bridging the gap between abstract and applied Mathematics by using visual models;
- Having students develop their own problem-solving strategies rather than memorizing rules and procedures;
- Making mathematical communication, perhaps in the form of journals or oral presentations, an integral part of the lesson; and
- Making connections to other disciplines using meaningful real-world problems.

The above components are the reality principle which emphasizes that RME is aimed at learners who are capable of applying Mathematics (Van den Heuvel-Panhuizen 2012: 13). Rather than commencing with certain abstractions or definitions to be applied later, learners commence with rich contexts in mathematical applications that afford understanding. Thus, like many progressive approaches to Mathematics education, RME strives to enable learners to use or apply their mathematical understanding and tools to solve experiential problems in the real world.

According to Ball, Hill, and Bass (2008: 29), mathematical knowledge for teaching is divided into two domains, namely subject matter knowledge that is regarded as mathematical content knowledge (MCK) and pedagogic content knowledge (PCK) as illustrated in Figure 2.6.

Figure 2.5: Domain map for mathematical knowledge for teaching



Source: Hill, Ball and Schilling (2008: 12)

Researchers have supported the notion that strong mathematical content knowledge is essential for quality teaching in Mathematics (Ball *et al.* 2008: 25). Teachers need to apply appropriate instructional strategies to provide learners with opportunities to develop their critical thinking and problem solving skills. Teachers must be able to present subject matter in multiple ways like using story problems, pictures, situations and concrete materials. This knowledge is required to choose the appropriate pedagogical strategy and instructional material for a lesson, to consider which tasks to set and which assessment techniques to use. Knowledge of content and teaching further assists teachers to reflect on their own practice for the purpose of improvement (Koellner 2011: 121). Figure 2.6 illustrates the domain map for mathematical knowledge for teaching. The MCK category comprises three strands, namely common content knowledge, specialized content knowledge, and knowledge at the horizon (Ball *et al.* 2008: 26).

Common content knowledge: Common content knowledge involves knowing central facts, concepts and principles within a relationship Content knowledge goes beyond knowledge of the facts or concepts of a domain to understand the structures of the subject matter.

Knowledge at the mathematical horizon: Knowledge at the mathematical horizon refers to having knowledge of the subject beyond the years for which a teacher is responsible. PCK category also consists of three strands that is knowledge of content and learners, knowledge of content and teaching and knowledge of the curriculum (Ball, et al. 2008: 31). The value of teachers having a deep knowledge base is still recognized as part of their complete knowledge base. This knowledge includes the most useful forms of representation of ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations in a word, the ways of representing and formulating the subject that makes it comprehensible to others (Shulman, 1986: 9).

Specialized content knowledge: Specialized content knowledge goes beyond common content knowledge. Teachers need to have specialized knowledge to know more than just explaining the content, but must be able to explain why it is so, why it is worth knowing and how to relate it to other learning outcomes and other disciplines, both in theory and practice.

PCK is divided into: knowledge of content and students; knowledge of content and teaching and knowledge of the curriculum.

- ❖ **Knowledge of content and students:** Putnam (2015: 8) focuses on two interrelated aspects of knowledge and beliefs. He argues that prospective and experienced Mathematics teachers' knowledge and beliefs serve as filters through which their students learning takes place and on the other hand teachers' content knowledge and knowing their students are critical targets for of change.

- **Knowledge of content and teaching:** This category of knowledge, curricular knowledge, refers to the knowledge about the full range of programmes designed for the teaching of different topics at given levels in a subject area (Ball *et al.* 2008: 31). It also includes knowledge regarding the variety of instructional materials available to teach particular components in Mathematics.
- **Knowledge of curriculum:** A teacher needs proper knowledge of the curriculum and a high level of PCK to assure effective teaching (Shulman 1986: 5 and Ma 1999: 17). Teachers also need to be familiar with the curriculum materials studied by learners in other subjects at the same time (Shulman 1986: 4). It is imperative for teachers to be familiar with the topics and their levels being taught in the same subject during the preceding and subsequent years in school.

Mathematical content courses and professional development are effective ways of enhancing the mathematical knowledge that primary and secondary teachers may require for their own classroom instruction of Mathematics. Content courses can help new teachers to become more prepared to teach and represent the increasingly important subject of Mathematics to their learners. A teacher needs to be a facilitator to create an environment that supports earners to construct their own mathematical understanding rather to solve the problem. The Mathematics teachers' knowledge in the primary school is paramount, as this would give them an overview of how the learning in Mathematics proceeds into secondary school. The Mathematics teachers' knowledge is equally important at secondary schools in preparing students for tertiary institutions and the real world. Certain scholars believe that implications for translating the content matter of Mathematics into effective pedagogical practice are paramount in raising the profile of Mathematics (Ball *et al.* 2008; Koellner and Sholtz 2007; Ma 1999, Shulman, 1986 and Potari, 2014).

2.11.2 Confidence

Confidence has been variously defined as a dimension attitude, an outcome of beliefs about one's self-efficacy in a particular situation, and as inherent in the process of learning and linked to identity formation. It is often assumed to be associated with ability and crucial to performance. There is evidence that many primary teachers lack confidence in their ability to teach topics in the Mathematics curriculum effectively (Beswick, Watson and Brown 2006: 70). Beswick, Callingham and Watson (2011: 5) state that 'Confidence' relates to beliefs about one's self and about one's efficacy to act within a social setting, in this case the Mathematics classroom. Research on confidence and causal attributions in relation to Mathematics tends to focus on beliefs about the self (McLeod 1992: 581). With national emphasis being placed on science, technology, engineering, and Mathematics (STEM) education is very important for high-quality teachers to provide effective Mathematics instruction (Ball *et al.* 2008: 30).

Primary school Mathematics is the most crucial phase to introduce foundational concepts and enduring attitudes, is usually taught by teachers. Levine (2013: 21) states that teachers reported an increase in their knowledge of Mathematics made them more confident for teaching the subject, and a more positive attitude for Mathematics. She further emphasizes that increasing the confidence of teachers for teaching Mathematics contributes to improving Mathematics instruction and learning. The national and global efforts to improve Mathematics knowledge demand that primary phase teachers, who introduce learners to mathematical learning, are confident in their ability to teach mathematics (Levine, 2013: 24). Confidence for Teaching Mathematics can contribute to improving the quality of Mathematics instruction at the elementary level (Levine, 2013: 25). She argues that meaningful concept development that engages students and provides a model of effective instruction for future teachers may contribute to increasing their confidence for teaching Mathematics. The national and global efforts to improve Mathematics knowledge demand that teachers, who introduce students to mathematical learning, are confident in their ability to teach Mathematics.

Schoenfeld (1989: 341) describes the role of self-concept in Mathematics education and notes that research has consistently revealed correlations between confidence and achievement. Confidence in Mathematics breeds success and those individuals who have high levels of confidence in their ability to learn Mathematics perform much higher than those with low levels (Schoenfeld 1989: 339). According to Pajares and Schunk (2001: 2) individuals tend to participate in tasks that they feel confident and competent in and avoid tasks that they believe they are not that competent or confident in. This correlation could exist because the strength of people's convictions in their own effectiveness is likely to affect whether they will even try to cope with given situations (Bandura 1997: 13). Learners who have a low self-concept in Mathematics will need help in changing their beliefs in order to build their confidence levels according to teaching and learning. Mathematics aims to develop in the learner the necessary confidence and competence to deal with any mathematical situation, without being hindered by a fear of Mathematics. It is vital for teachers to instill confidence in learners and to allow them to develop positively in the Mathematics class. It is imperative that learners enter secondary school with a secure foundation in Mathematics. Coryoth (2007: 4) states that the current trend in Mathematics education is largely generally is an extension of an existing trend in the quality of Mathematics education.

Mathematics is the subject that has the highest number of failures in the National Senior Certificate Examination conducted in South Africa. This is an indication that Mathematics is in dire straits. Graven (2004: 178) has theorized that confidence is both a result of learning and successful learning leads to increased confidence. Confidence thus contributes to learning. Graven (2004: 179) states that confidence is relevant to the teachers' ability to access resources, to participate in mathematical activity, and to be competent. Based on the assumption that primary and secondary school teachers' mathematics teaching efficacy beliefs affect the quality of their Mathematics instruction, the focus was on the factors that related to Mathematics teaching efficacy beliefs.

2.11.3 Self-efficacy

Self-efficacy in teachers is regarded as context specific and subject matter specific (Schunk 2012: 17). An individual's self-efficacy will influence the amount of effort, persistence, and resilience they will put forth in the face of obstacles and likewise, a teacher's instructional efficacy will influence his or her teaching practices (Bandura, 1977: 3; Schunk, 2012: 18). According to Bandura, (1997: 2) self-efficacy "is the belief in one's capabilities to organize and execute the courses of action required to manage prospective situations". In other words, self-efficacy is a person's belief in his or her ability to succeed in a particular situation such as in a Mathematics class. (Kim, Sihn and Mitchell 2014: 13) state that teacher efficacy is associated with mathematical instructional quality and student confidence. They further argue that Mathematics teachers are one of the major factors related to students' achievement. To think more about ways to promote teachers' self-efficacy, they examined South Korean elementary teachers' Mathematics self-efficacy beliefs and what factors increase their efficacy beliefs. A translated and adapted version of the Mathematics teaching efficacy belief instrument was used to gather information on teachers' Mathematics teaching efficacy beliefs and their background information. Based on statistical analyses it was concluded by (Kim *et al.* 2014: 15) that South Korean Mathematics teachers' self-efficacy beliefs differ by educational level in the teachers' Mathematics education, certification level, and range of teaching experience. They further explain that self-efficacy beliefs increase with experience, on average, with the highest occurring in teachers with between eleven and fifteen years of experience, then decline after fifteen years, possibly because of a reduction in certification and professional development participation after that time. However, they emphasized that novice elementary teachers who have 0 to 5 years of teaching experience have the lowest Mathematics teaching efficacy beliefs. (Angle *et al.* 2009: 481 and Kim *et al.* 2014: 16) concurred that current pre-service teacher education programmes in Mathematics should consider developing more effective workshops that help pre-service elementary teachers increase their Mathematics self-efficacy beliefs.

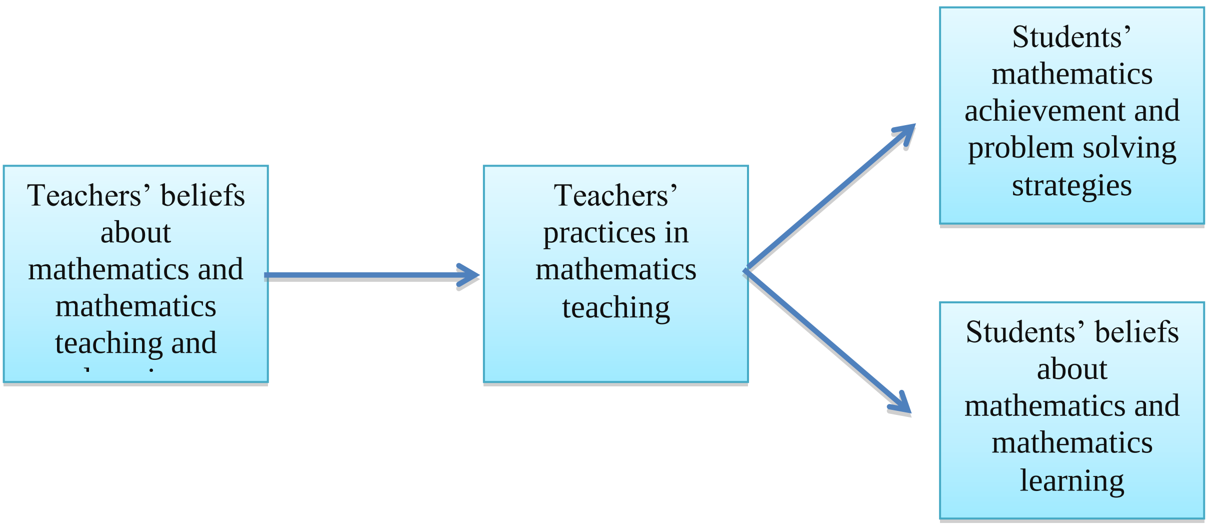
Bandura (1997: 7) describes these self-efficacy beliefs as determinants of how people think and behave, their attitudes, abilities, and skills in Mathematics. This system plays a major role in how situations are perceived and how one behaves in response to different situations. Self-efficacy plays an essential role in the learning of Mathematics. Moodley (2011: 13) states that learners may develop negative perceptions towards Mathematics and self-efficacy expectations dictate the level of effort a learner is willing to expend when faced with a difficult problem in Mathematics. Teacher beliefs about their personal effectiveness or efficacy have been the subject of several recent studies. McLeod and Reynolds (2007: 19) state that beliefs play a key role in the construction of emotion and the development of attitudes. Some researchers have suggested that teachers' efficacy beliefs influence learners' motivation and achievement. Bandura (1997: 12) states that performing a task successfully strengthens one's sense of self-efficacy. However, failing to adequately deal with a task or challenge can undermine and weaken self-efficacy. Parsons (1980: 9) adds that expectations of personal efficacy are based on four major sources of information: performance accomplishment, vicarious experience, verbal persuasion, and physiological states. Learners who become extremely nervous in Mathematics may develop a weak sense of self-efficacy. Self-efficacy is one's belief in one's ability to complete a task. If the learner has a low self-efficacy belief, it is most likely that their performance will be poor (Bandura 1997: 21). McLeod and Reynolds (2007: 19) argue that there will only be improvements in Mathematics education once the affective responses of both children and adults have changed. Self- efficacy expectations dictate the level of effort a learner is willing to expend when faced with a difficult problem in Mathematics. Teachers with high self-efficacy will impact on student learning outcomes and are more innovative and exhibit more effort in their teaching (Bandura 1997: 23).

Kim *et al.* (2014: 15) state that teacher self-efficacy beliefs focus on successfully performing teaching tasks in a teacher's current teaching condition, including specific surroundings such as a school or a classroom and self-efficacy is focused on successfully affecting student performance. They also concluded that teachers who believe that effective teaching can affect student learning and those who have confidence in their own teaching abilities may provide a greater academic focus in the classroom and offer diverse feedback according to the students' academic backgrounds, more than teachers who have low Mathematics self-efficacy beliefs.

2.11.4 Beliefs

The perception that the worldviews, beliefs and values of teachers might influence their students has been an educational research focus in recent years (Zhang and Wong 2014: 11). McLeod and Reynolds (2007: 22) state that beliefs play a key role in the construction of emotion and the development of attitudes. They also suggests that beliefs develop over time, and that learners develop beliefs that are in line with their personal experiences. There is no single, exact definition of the term ‘belief’. (Schunk 2012: 28) states that learners’ have beliefs about Mathematics learning, self-belief, beliefs about Mathematics teaching and beliefs about the context in which Mathematics education occurs. McLeod and Reynolds (2007: 23) argue that learners’ beliefs about Mathematics may include the belief that Mathematics is difficult and their teachers affect the beliefs that learners hold. As teachers set an example for their learners every day, their beliefs about themselves and their learners have an impact on learner beliefs in their classroom. Teacher beliefs also have an impact on their own instructional practices in the Mathematics class. Chan and Wong (2014: 261) from the National Council of Teachers of Mathematics stated that teachers of Mathematics with more Mathematics courses would not necessarily influence their beliefs and awareness, although it may improve their mathematical and pedagogical knowledge. Zhang and Wong (2014: 16) report their findings in teacher beliefs as illustrated in figure 2.7 associated with Mathematics teachers' beliefs.

Figure 2.6: Teachers’ beliefs and practices and students’ learning



Source: Zhang and Wong (2014: 7)

Zhang and Wong’s (2014: 16) study concluded that as teacher education programs shape teachers' beliefs, they must acknowledge that teachers’ personal experiences, and practices shape students’ beliefs about Mathematics and learning mathematics.

Chan and Wong (2014: 253) argue that teacher characteristics, professional qualifications, and teaching contexts relate to teachers' beliefs about Mathematics teaching and learning and teachers' awareness of their students' mathematical dispositions. The authors conclude that that (1) it is imperative that Mathematics education researchers strive for a better understanding of potential influences on teachers' beliefs and awareness, and (2) there are potential influences on teachers' beliefs and awareness that appear to extend beyond the domain of teacher education. Another major type of belief in Mathematics teacher education focuses on the subject area and its teaching and learning (Goldsmith, Doerr, and Lewis 2014: 15). They argue that beliefs contain two different aspects: epistemological beliefs about the subject area, which are the nature of knowing and the process of knowing. The other include beliefs about concepts of teaching and learning in Mathematics, based on learning theories (Dubberke, Kunter, Mcelvany, Brunner and Baumert 2008: 201). They argue that a changing environment influence how teachers behave in the class-room and how they cope with such changes. Goldsmith *et al.* (2014: 17) state that the beliefs have the effect of a lens through which teachers view their world and this influences how they interpret and evaluate the relevance of incoming information and analyzing teachers' beliefs, addresses challenges of how to implement didactical concepts or choose contents and learning goals out of various possibilities with few existing standards. Therefore, the role of beliefs and motivational orientations is important because they are supposed to influence how teachers perform their duties in the classroom and how they cope with a changing environment.

Studies on beliefs about Mathematics and Mathematics teaching and learning have been conducted among both students and teachers in the Chinese regions of the Chinese mainland, Taiwan and Hong Kong by (Zhang and Wong 2014 and Chan and Wong 2014) and they found that students' and teachers' beliefs mirror each other: they believed that Mathematics involves thinking and it is useful. There are numerous factors influencing teachers' beliefs about Mathematics and Mathematics teaching and learning, as stated by Zhang and Wong (2014: 16) and one such important factor is that teachers' worldviews aim to help students obtain high scores in public examinations may conflict with students' genuine understanding of mathematical concepts, and teachers' worldviews might influence how they approach this dilemma.

They further state that worldview refers to "one's comprehensive set of beliefs about the nature of reality and how one should live in the light of those beliefs. Another interesting observation by (Zhang and Wong 2014: 17) is that teachers learning experiences or teaching experiences play a role in shaping their beliefs about Mathematics education. Beliefs and motivational orientations are relevant for teaching Mathematics and these aspects have an impact on learners' school education.

2.12 Gap in Mathematics education

At a time where sustainable development is being put forward as a prime objective for most governments around the world, it is recognized that education will have a critical role to play (UNESCO 2012: 2). Cheng (2003: 209) states that if education does not cater for the future needs and challenges of the new millennium then it is ineffective for the new generation. The result of quality education is not about achieving high grades and mere academic excellence but the total development of the learner. Cheng (2003: 211) therefore concludes that the ability for education to meet the needs of the future both at individual and societal level is one of the critical elements of quality in education. Holloway (2004: 85) emphasizes that lack of Mathematics preparation in the earlier grades takes its toll later on. The National Center for Education Statistics (2003: 5) in the US state that white students and Asian/Pacific Islander students continue to outperform black, Hispanic, and American Indian/Alaskan native students at every grade level. Barton (2003: 19) has shown that minority students face numerous academic barriers to achievement, both in the classroom and outside of school. One factor that shows up in his research is that minority students as a group experience a less rigorous curriculum. Lower expectations for these students often preclude the opportunity for them to take more rigorous courses because of inadequate prior preparation. To overcome racial inequities in Mathematics instruction, the National Council of Teachers of Mathematics (NCTM, 2003: 13) suggested six principles based on curriculum reform:

- High expectations for all students;

- A coherent curriculum of important Mathematics, articulated across grade levels;
- Teachers who understand what students need to learn and then challenge and support them;
- Instruction that builds new knowledge from experience and prior knowledge;
- Assessment that supports learning and provides useful information to both teachers and students; and
- Technology that influences the Mathematics taught and enhances students' learning.

Researchers suggest that when these principles are applied to practice, they can improve equity and quality teaching in Mathematics. Schoenfeld (2002: 14) stated that to ensure sustained improvement in Mathematics instruction, schools must provide a high-quality curriculum; a stable, knowledgeable, and professional teaching community; and high-quality assessment aligned with the new curriculum. Both NCTM (2003: 15) and Schoenfeld (2002: 23) emphasize that the traditional curriculum is one that does not emphasize the kinds of Mathematics that would enable students to make sense of the world around them; instead it focuses on preparing a small percentage of students for college or university-level work and contains little or no emphasis on communicating and using mathematical ideas. They further stated that the reform curriculum should provide all students with the mathematical background for quantitative literacy for the workplace and for tertiary study. Holloway (2004: 86) argues that to improve the chances of success for achievement in Mathematics, schools should provide students with a rich standards-based curriculum, aligned and articulated across grade levels, that supports high expectations for all students. UNESCO (2012: 3) advocates that the reform curriculum, combined with greater teacher sensitivity to the needs of students, can become a powerful force in closing the Mathematics achievement gap.

In the United Kingdom (2012: 14) report, indicates that over one-fifth of pupils are leaving primary school without a secure grasp of essential mathematical skills, 5% of 11 year olds leave primary school with mathematical skills that are at the level of a seven year old. The United Kingdom began a ten-year programme to train 13,000 specialist Mathematics teachers for teaching Mathematics in the primary schools. In the USA, The National Commission on Mathematics and Science Teaching (2012: 7) implemented a Program for International Student Assessment (PISA) tests, which measure learners' ability to apply scientific and mathematical concepts and skills. This test was administered to 15-year-olds in the USA to ascertain the quality of learning that is taking place in the USA. Learners scored below the international average. They also implemented policies for teachers to participate in professional development. By improving the quality of Mathematics teachers, learners would be provided with better quality education.

2.13 Improving the quality of Mathematics teaching and learning

Improving mathematical outcomes requires changes to elementary Mathematics education and children form beliefs about what Mathematics is and themselves as mathematicians very early in their school careers (Claessens and Engel 2013: 17; Lavy and Sand 2015: 173). Children enter kindergarten with great confidence in their mathematical abilities, but gradually their enthusiasm for the subject declines the longer they are in school (Carpenter, Fennema, Franke, Levi and Empson, 1999: 26). Central to raising learner achievement in Mathematics is improving the quality of Mathematics teaching and learning. Learners who receive high-quality instruction experience greater and more persistent achievement gains than their peers who receive lower-quality instruction (McGraner, Van der Heyden and Holdheide, 2011: 4). They also concluded that learners who were taught by a highly effective teacher achieved a gain of 1.5 grade equivalents during a single academic year, whereas learners enrolled in classes taught by ineffective teachers gained only 0.5 grade equivalents in the same year.

It is widely accepted that teachers need to bring a repertoire of robust content and pedagogical content knowledge of their own to the design and delivery of Mathematics lessons (Ball *et al.* 2008: 25; Shulman 1986: 11). In characterizations of mathematical learning outcomes for students, it is not uncommon to find that a good deal of attention is given to the acquisition of knowledge and skills in deploying prior knowledge in the solution of problems both abstract and real-life (McGraner *et al.* 2011: 5) and a key challenge for Mathematics teachers is to better understand how students learn (Goldsmith *et al.* 2014: 19). Research on Mathematics teaching suggests that many teachers do not possess the prerequisite subject-matter knowledge to implement high-quality instruction. Ball *et al.* (2008: 43) and McGraner *et al.* (2011: 17) argue that teachers must know in detail and from a more advanced perspective the mathematical content they are responsible for teaching and the connections of that content to other important Mathematics, both prior to and beyond the level they are assigned to teach. The logic herein is that teachers who possess strong mathematical knowledge at a greater depth and span are more likely to foster learners' ability to reason, conjecture, and problem-solve, while also being able to more accurately diagnose and address learners' mathematical misconceptions and computational skills. Claessens and Engel's (2013: 20); findings suggest that preparation and professional development programs for Mathematics teachers should emphasize the mathematical topics for student mastery and ensure that teachers possess a strong knowledge base in the topics that learners must master. The idea is that teachers need to cater more for the learners to better understand and engage in Mathematics. The National Council of Teachers of Mathematics (2014: 7) emphasizes the lack of essential practices for quality reform teaching. They also reiterated that reform teaching and learning environments help to develop robust understanding of Mathematics by encouraging all learners to participate in mathematical discussion, ask mathematical questions, make conjectures and solve problems.

According to Ball *et al.* (2008: 41) quality teaching in Mathematics might not relate much to performance on standard tests of Mathematics achievement as it does to whether teachers' knowledge is procedural or conceptual, whether it is connected to the curriculum, or whether it is compressed or conceptually unpacked. They are of the opinion that learning might result not only from teachers' content knowledge but also from the interplay between teachers' knowledge of learners, their learning and strategies for improving that learning. Missing out on the learning skills of Mathematics or failing to develop these skills is not just a loss for the individual: it is also an enormous loss to the learners. Mastering the skills of Mathematics brings with it many social and economic benefits for the individual and society as a whole.

Researchers and educators need to continue to seek new pedagogies to improve the quality of Mathematics teaching and learning in their classrooms.

2.14 The quality gap in educational services

Schools face increasing pressure to meet the demands in the pass rate for matriculants because these learners need to get into tertiary institutions. Growing returns to post secondary education and decreasing employment makes it imperative for learners to complete a degree that is necessary for upward mobility. Deming, Hastings, Kane and Staiger (2014: 1010) state that improving the quality of high school education has become a first-order issue for economic growth and national competitiveness. Khanli; Daneshmandi and Choobineh (2014: 114) state that the quality of educational services can be considered as a basis for planning quality promotion and improving organizational performance.

Deming *et al.* (2014: 1011) argue that the benefits of choice are greater for secondary learners who experience larger gains in school quality. Juran (1998: 27) emphasizes that "Quality" means free from deficiencies. Shireen (2014: 32) is of the view that the concept of quality circle adopted for a variety reasons increases of product quality, involvement in decision-making, mutual help and customer satisfaction. She also emphasizes that another use of quality circle improved communication within the organization where employees identify routine problems through circle meeting and managers get to know employees needs. Shireen (2014: 33) emphasizes that quality circle helps to improve working environments in the following ways:

- ❖ Improvement in quality and productivity.
- ❖ Promoting job involvement and sense of participation.
- ❖ Provide a problem solving and problem-preventing attitude.
- ❖ Developing creativity and an innovative spirit.
- ❖ Inspiring teamwork and developing harmonious relations among workers.
- ❖ Help to develop positive attitudes among workers.
- ❖ It increases product quality and decrease defective problems.
- ❖ Strong communication between employees and management.
- ❖ It helps to improve organization environment and make better environment for

employees.

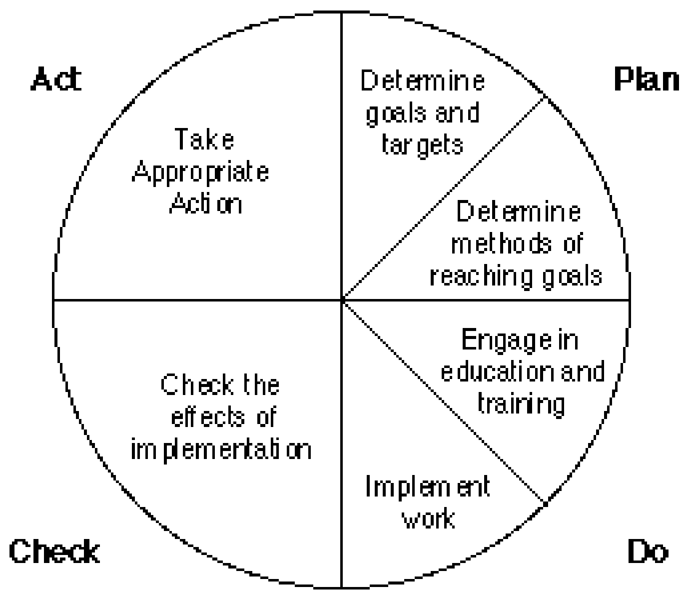
- It increases self development and social development.
- It is helpful tool to reduce complain and error.
- Increase working capacity.

Deming *et al.* (2014: 991) argue that improving the quality of high school education is important because students from low-quality neighborhood schools differ systematically by income and prior test scores, and those characteristics may drive the gains from choice which impacts greatly in the low-quality neighborhood school which includes race and poverty. Ishikawa (1915-1989) was a Japanese professor, who advocated the innovative developments within the field of quality management and is best known for the development of the concept of the fishbone diagram in Figure 2.9, which is also known as the 'Ishikawa diagram'. This diagram is used in many organizations for diagnosing or taking concrete actions in which the root cause of the problem is identified. Ishikawa (1986: 6) urged top-level executives to take quality control courses, knowing that without these support, management would ultimately fail. He stressed that it would take firm commitment from the entire hierarchy of employees to reach the company's potential for success. Another area of quality improvement that Ishikawa (1986: 7) emphasized is quality throughout a product's life cycle and not just during production. Although he believed strongly in creating standards, he felt that standards were continuous quality improvement programs and should be constantly evaluated and changed. Besides his own developments, Ishikawa (1986: 6) drew and expounded on principles from other quality gurus, including those of Deming *et al.* (2014), Juran (1998) and Shireen (2014); expanded Deming's four steps which is illustrated in Figure 2.8 into the following six principles:

- Determine goals and targets.
- Determine methods of reaching goals.
- Engage in education and training.
- Implement work.
- Check the effects of implementation.
- Take appropriate action.

The history of Quality Circle began in 1945 when two atom bombs were dropped on Japan and the whole economy crumpled into smoke and dust and about 220 000 people were killed (Ishikawa, 1986: 6). Hayashi, (2015: 1) reported that it was a thought that Japan would not get its glory again, but Japan rose like a phoenix from the ashes to become a leading nation of the world within a short period of time. Japan sustained fierce determination and commitment from the Japanese people and their quest for quality aspect (Ishikawa 1986: 6) and they adopted Quality Circle as a way to improve quality and to be competitive.

Figure 2.7: Categories of potential root causes of underperformance



Source: Deming *et al.* (2014: 1004)

Root cause analysis seeks to go beyond the symptom-level solutions to problems and to find the underlying true cause of the problem or deficiency being observed. With an understanding of the root cause of the problem, managers at schools and in the education sector can develop the most effective and lasting solutions. Further, going through a structured root cause analytical method often leads to findings that differ from the participants' initial assumptions. The process of root cause analysis requires those with differing perspectives on the problem to work together to perform the analysis. This collaboration is the starting point for establishing a broad base of support for the solutions that will later be developed. The following primary categories stated by Deming *et al.* (2014: 1004):

- ❖ Instructional guidance addresses the curriculum content that students are exposed to, the organization of that content, and the tools teachers have access to (e.g., instructional materials, pedagogies, assessment methods). Organization of the curriculum includes the subject matter information learners are exposed to and how it builds over time. Districts might consider issues such as lack of standards or a common curriculum, especially in core subject areas (reading, Mathematics and Science), insufficiently cost-effective intervention strategies for struggling learners or weaknesses in the pedagogies or assessment systems used. Districts could examine, for example, how teachers' work is organized and possible lack of effective collaboration and the level of learner engagement in lessons.

Deming *et al.* (2014: 1006) outlines the professional capacity category which addresses the district's ability to recruit and retain quality staff on the following basis:

- ❖ The quality of performance feedback and professional development systems, a constructive organizational culture, and teamwork standards. In particular, districts should examine: quality of human resources and this covers how new teachers are recruited, where they are recruited from, and how they are oriented. It also includes how teachers and school managers are selected and given feedback and how instances of underperformance are addressed.
- ❖ Quality of professional development. Teachers' continued professional development should relate directly to the district or schools' strategies to improve learner achievement. Lack of instructional coaches may also impede effective professional development.
- ❖ Constructive organizational culture. A high-performing school is characterized by a culture that emphasizes continuous improvement, which exhibits willingness to identify and stop ineffective practices and change practices where necessary, and which sets high expectations for learners regardless of their socio-economic background. The absence of these same features may contribute to underperformance in a school.
- ❖ Professional community. Three features of a high-performing professional

community include a willingness by teachers to make their work available for examination by colleagues; collaborative critical examination of learning methods, processes, and outcomes; and regular collaborative teaming between teachers to strengthen the curriculum.

- School learning climate. This category addresses the beliefs, values, and behaviors among staff, learners, and parents.

Districts could examine:

- Order and safety. As a prerequisite to effective learning, schools must be orderly and learners must have a high perception of their personal safety.
- Teachers' academic expectations of learners and support. The district's faculty should hold all learners to high standards. However, these standards must be accompanied by support mechanisms to help struggling or disadvantaged learners meet these standards.
- Peer academic norms. When students comply with accepted behavioral and academic norms, it reduces disruption to instruction and promotes learning (Ishikawa 1986: 9).

Secondary Categories:

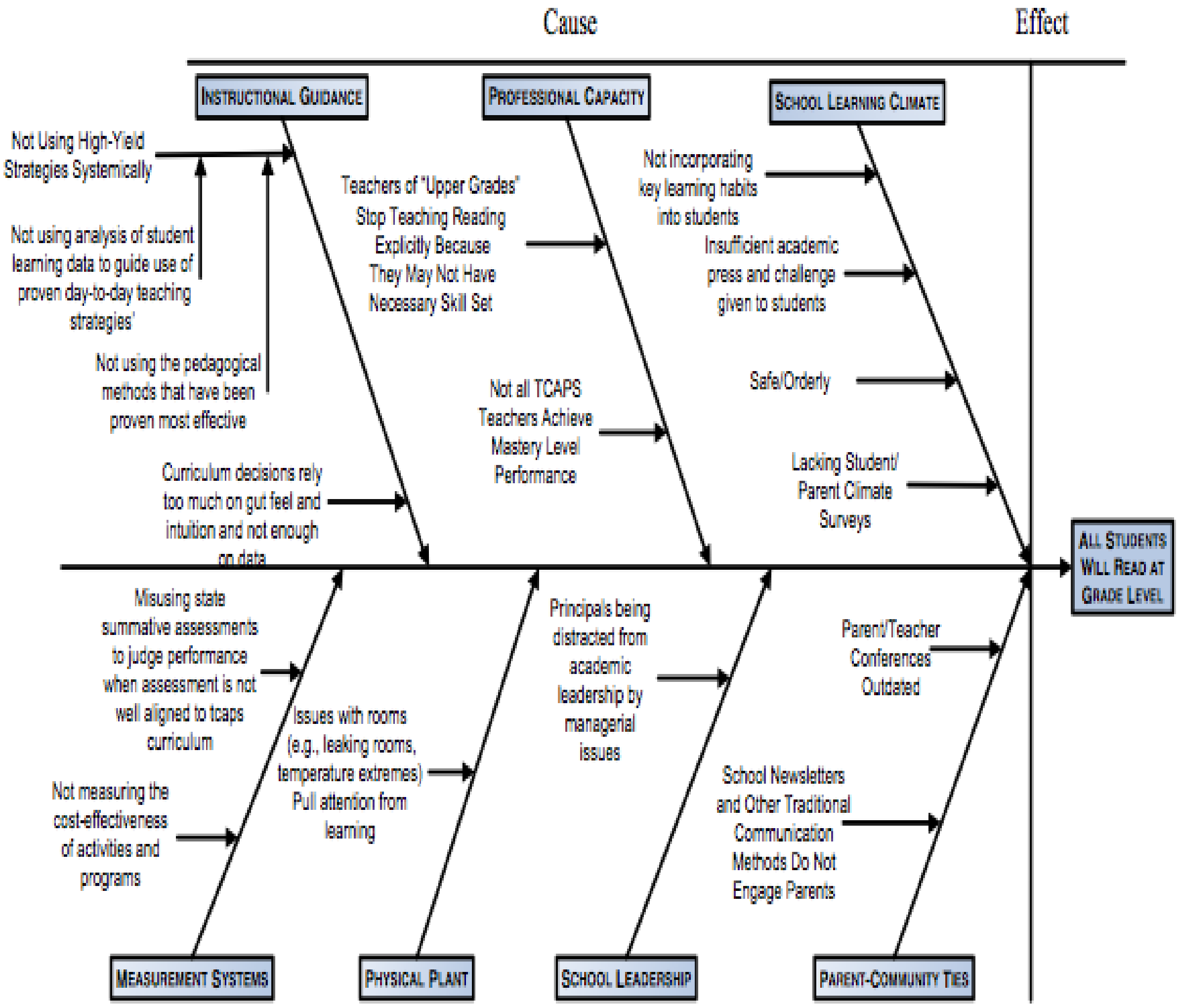
- School's parent-community ties. Schools will be more effective in reaching their student achievement goals if: they engage parents directly in the process to strengthen student learning; teachers make an effort to become knowledgeable about the local community and student culture and draw on this awareness in their lessons; and they form an effective support network with community organizations.
- School leadership and management. District and school-level leadership is a critical lever for making positive change. Effective leadership includes the following dimensions: managerial, such as scheduling, logistics, equipment, facilities, and finances; instructional, such as providing feedback to teachers and directing the implementation of effective instructional techniques; and, finally, leading change.
- Physical plant. The condition, location, and layout of physical facilities could impact learning, as could the functionality of equipment and technology, or the adequacy of other learning aids (e.g., textbooks). Juran (1998: 154) argues that human resources and healthy human relations are very important. He is of the view

that the immediate objective of human resource management is to achieve healthy human relations throughout the organization. Healthy human relations are relations that are open, positive, and efficient. Healthy human relations contribute to the employees' sense of ownership, to good business results, and Deming (1986: 1009) called that "joy in the workplace" whereby it is easier to achieve other organizational objectives in an environment of healthy human relations.

Figure 2.8 is a fishbone diagram of a template completed by a Traverse City Area Public Schools (TCAPS), Michigan for the problem that not all students read at grade level. The diagram shows how TCAPS investigated a variety of causes behind the problem. TCAPS used data from a number of published research studies to aid their analysis. For example, what are the most effective pedagogical methods in the classroom? What are the successful habits of student learning? State the most effective pedagogical methods in the classroom? What are the successful habits of student learning and its TCAPS helping students to learn those habits and is TCAPS following all? To attain quality, it is well to begin by establishing the "vision" for the organization, along with policies and goals. A fishbone diagram Ishikawa (1986: 6) is a tool that can help managers perform a *cause and effect analysis* for a problem that one is trying to solve as illustrated in figure 2.9 on page 70. A *cause and effect analysis* enables managers to discover the root cause of a problem. The left side of the diagram is where the causes are listed. The causes are broken into major cause categories. The causes that have been identified will be placed in the appropriate cause categories as the diagram is built on. The right side of the diagram lists the **effect**. The effect is written as the **problem statement** for which managers are trying to identify the causes. A cause and effect diagram can be created in six steps as follows:

- Draw Problem Statement
- Draw Major Cause Categories
- Brainstorm Causes
- Categorize Causes
- Determine Deeper Causes
- Identify Root Causes

Figure 2.8: Cause and effect diagram with the school categories based on Fishbone diagram



Source: Ishikawa (1986: 6)

Fishbone diagrams are an excellent way to explore and visually depict the causes of problems at schools. They enable the root causes of a problem to be determined. This will help all role players to be more effective by focusing on the actions of the main causes of a problem and not on its symptoms.

Conversion of goals into results improves quality teaching and learning at school. Managing for quality education makes extensive use of three such managerial processes: quality planning, quality control and quality improvement. These processes are known as the "Juran trilogy" (Juran 1998: 34) that emphasizes that quality planning provides the process, methods, tools, and techniques for closing each of these component gaps and thereby ensuring that the final quality gap is at a minimum. Juran (1998: 37) further stated that upper management must take the leadership in identifying and supporting the critical quality planning projects. Acting as a quality council, management needs to fulfill the following key roles.

❖ ***Setting Quality Goals:*** Top management identifies opportunities and needs to improve quality and sets strategic goals for the organization.

❖ ***Nominating and Selecting Projects:*** The quality council selects major quality planning projects critical to meeting strategic quality goals.

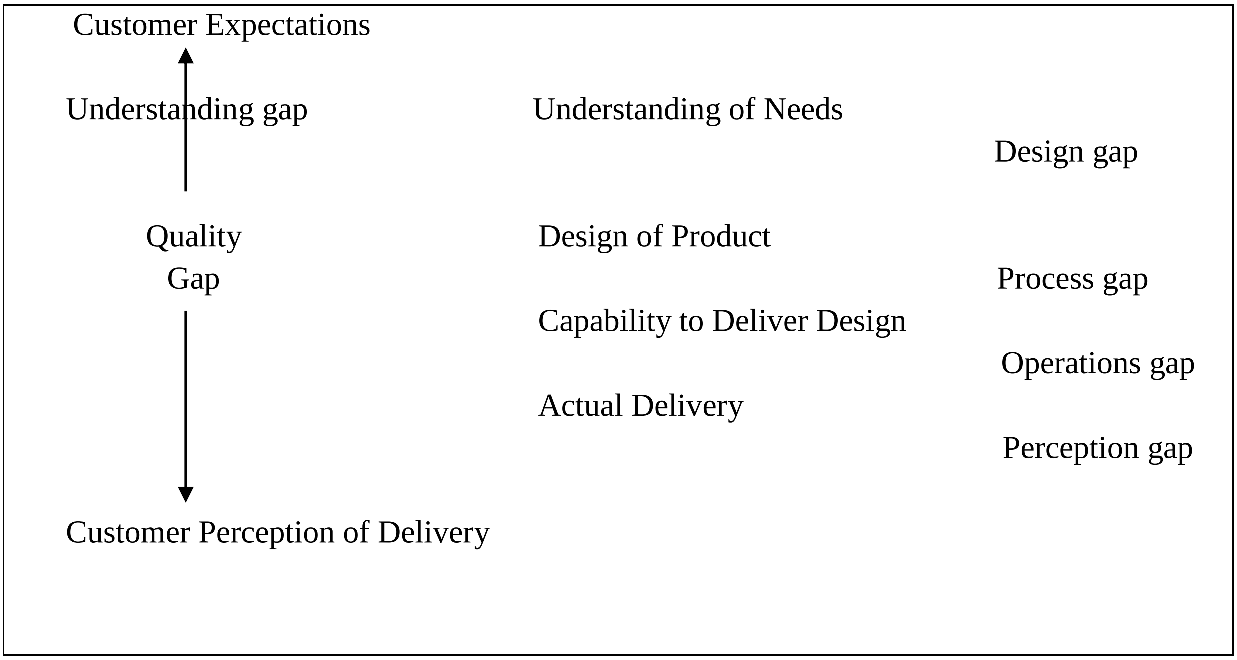
❖ ***Selecting Team:*** Once a project has been identified, the quality council appoints a team to see the project through the remaining steps of the quality planning process.

❖ ***Supporting Project Team:*** New techniques and processes are generally required to meet quality goals.

The final perception gap in Figure 2.10 arises from a failure to understand customer and customer needs which is compared to the failure to provide quality education. Juran (1998: 37) states that the first component of the quality gap is the *understanding gap*, that is, lack of understanding of what the customer needs. Sometimes this gap widens because the producer simply fails to consider who the learners are and what they need. More often the gap is there because the supplying organization has erroneous confidence in its ability to understand exactly what the learners really need. It is essential to understand the needs of learners.

Customers react to how they *perceive* the good or service provided to them. The second constituent of the quality gap is a *design gap.* Even if there were perfect knowledge about customer needs and perceptions, many organizations would fail to create designs for their goods and services that are fully consistent with that understanding. Some of this failure arises from the fact that the people who understand customers and the disciplines they use for understanding customer needs are often systematically isolated from those who actually create the designs. In addition, designers whether they design sophisticated equipment or delicate human services often lack the simple tools that would enable them to combine their technical expertise with an understanding of the customer needs to create a superior product.

Figure 2.9 The quality gap and its constituent gaps



Source: Parasuraman, Zeithaml, and Berry (1994: 43)

The third gap is the *process gap.* Many splendid designs fail because the process by which the physical product is created or the service is delivered is not capable of conforming to the design. This lack of process capability is one of the most persistent and failures in the total quality gap. The fourth gap is the *operations gap.* The means by which the process is operated and controlled may create additional deficiencies in the delivery. This may be the case of changing policy reforms where they have been formulated and has the four gaps as mentioned and illustrated in Figure 2.10.

Khanli *et al.* (2014: 116) state that schools need to improve the following aspects:

- ❖ the appearance of the school, physical facilities and equipment,
- ❖ personal and communication materials,
- ❖ reliability, the school's ability to perform the promised services dependably and accurately,
- ❖ responsiveness, the school’s willingness to help learners and provide prompt service,
- ❖ assurance, by the knowledge and courtesy of school office staff/faculty and

their ability to convey trust and confidence and empathy and

- ❖ the school staff to provide a caring and individualized attention to all learners.

2.15 Successful international education models

The UK Government aimed to establish a national network of schools as part of the policy of developing a self-improving school system (Gu, Rea, Smethem and Dunford 2014: 7). The National College for Teaching and Leadership developed the 'Schools White Paper' for the evaluation of schools in the UK. The evaluation was intended to track the development of the teaching school alliances and also to engage in the examination of the performance and impact of all teaching school alliances through a national survey. The UK evaluation system as described by Gu *et al.* (2014: 13) is based on the delivery of the 'Big 6' that are as follows:

❖ **Initial teacher training (ITT) and (CPD)/leadership development**

The quality of the ITT and CPD/Leadership Development empowers all stakeholders. The Improving Teacher Programme (ITP) and the Outstanding Teacher Programme (OTP) are well-established across the UK to enhance teaching and learning.

❖ **School-to-school support**

Training and support are provided to all schools in the UK.

❖ **Specialist leaders of education (SLEs)**

The SLE role is providing valued and attractive leadership development opportunities and experience for excellent middle and senior leaders.

❖ **Succession planning and talent management**

There is clear evidence of talent management and leadership development in the case study teaching school alliances. The teaching is perceived to have provided new opportunities to develop and retain outstanding teachers.

❖ **Research and development:** The development of research has its partnership with higher education institutions that provide promising research and development opportunities for teachers.

- ❖ **Development of teaching school alliances**

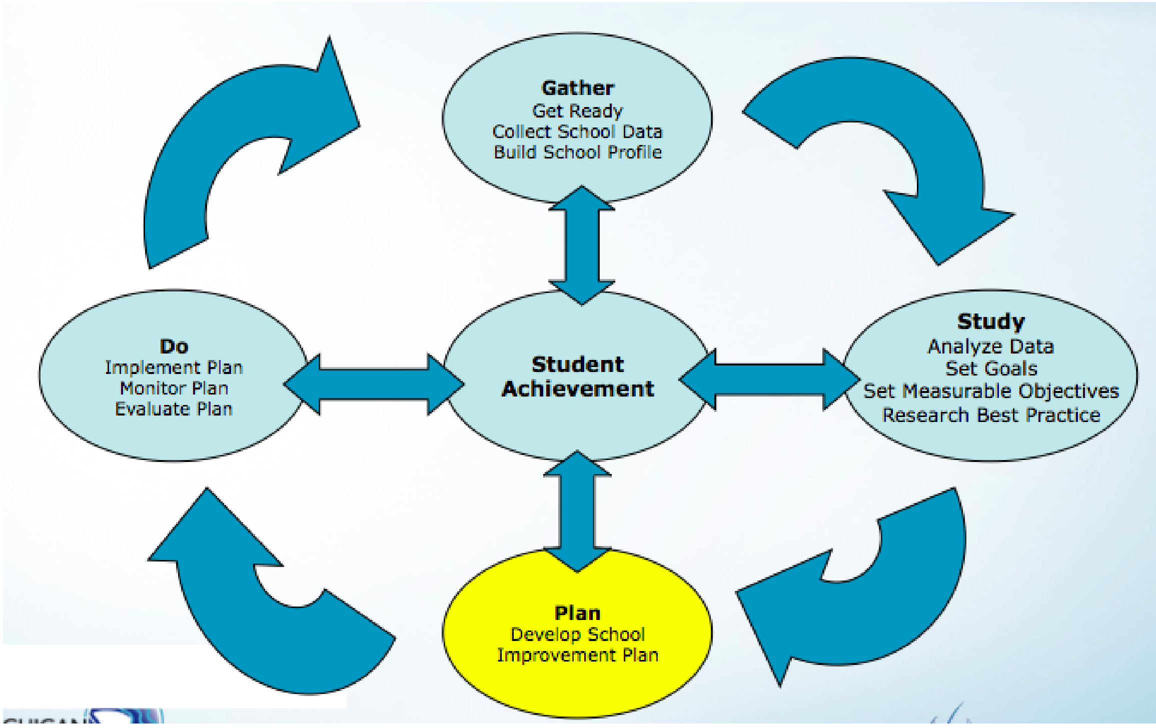
All school alliances in this evaluation progressed and are driven by a sense of direction, shared values and recognition that all role players have talents, experience and skills to share.

The Michigan Department of Education (2014: 6) has attempted to bring together the various states in the US for school improvement with a common vision. It is the intent of the Department that school improvement is a continuous process, not a one-time event. The School Improvement Plan in Figure 2.4 is the intended vehicle that drives the continuous improvement process. Figure 2.4 also addresses the students' needs. A specific, planned, research-based and/or evidence-based instructional practice is used. The curriculum addresses practices that were identified as challenges in the needs assessment.

This process cycle provides the foundation to address school improvement and promote student achievement through a comprehensive and systemic approach consisting of the following main tasks (Michigan Department of Education 2014: 9 and Connecticut State Department of Education 2014: 8):

- ❖ **Gather - collect data and build school profile**: A database of all teachers would help to obviate a shortfall of specialist teachers in subjects in which learners under-perform.
- ❖ **Study - analyze data, set goals and objectives**: Through well-designed student learning goals and objectives, a leader can drive the improvement of instructional practices at the school or program level, thereby improving student learning at scale. Student learning goals and objectives should provide the focus for concerted actions between administrators and teachers. The administrator as instructional leader utilizes meeting times; local and external expertise; data discussions with teams or departments; and other strategies and resources to focus the instructional practices of teachers on student learning priorities.

Figure 2.10: Process cycle of Michigan's continuous school improvement plan



Source: Michigan Department of Education (2014: 5)

❖ **Plan - develop an improvement plan**: The physical environment in schools supports participatory learning in many ways. Most importantly, classrooms are structured so that students can easily work co-operatively. Explicit instruction and practice occurs in the structured therapy setting with individualized activities developed to encourage awareness development, including the use of technology and high interest iPads and computers. Data will be kept in order to assess the current needs of individual students in order to guide planning and instruction. Ongoing consultation with teachers to assist with planning strategies is critical for sustaining improvement.

❖ **Do - implement, monitor and evaluate this plan**: Use cues, questions and advanced organizers to help students make sense of real world problems and apply what they already know to promote new learning. The quality of administrative support and leadership is another critical element in school processes, both for students and for teachers (Michigan Department of Education 2014: 13).

Organizational support for teaching and learning is important and measures in advocating for better conditions and professional development; respecting teachers' autonomy and professionalism; and developing inclusive decision-making processes are necessary. Positive teacher support, has been shown to have impact on student learning (Putnam 2015: 24).

Schools need to focus on maximizing each student's growth and individual success to develop a specific result. Needs can enable learners to gain qualifications and offer them opportunities. Putnam (2015: 24) emphasized that there is a need for stability and the skills are mismatched between education and employment. He maintained that key aspects are as follows: (1) it is important to get education right; (2) no education system can be better than the quality of the teachers and the standards in place; (3) teacher training needs to be non-negotiable and continuous; and (4) a global acceptance of the importance of education of women is key as it could build better-educated families. Evaluation is linked to the measurable objective that is ultimately linked to the student goal and student quality. Education should be the driver of change, not the recipient. It should pave the way for the construction of a better life and a system of values and ethics through which people can live together. It is important to have pedagogical optimism in education a sector inherently about change thus having a considerable advantage over other social systems. The power of design in education in order to challenge pedagogical gravity and find creative and effective ways of engaging children in schools needs to be harnessed.

While many South Africans live in challenging circumstances, schools provide one of the few levers for improving the life chances of deprived children and young people. The adoption of such rigorous programs as applied in the UK; the Michigan's Continuous School Improvement Plan; and other progressive countries will elevate the South African teaching and learning strategies, especially in driving Mathematics to the forefront. Educator evaluation and support systems with the primary goal of developing a talented workforce are required to provide a superior education for students in the 21st-century that, in turn can help to provide learners with a better life for them, and their families, and contribute to South Africa's economic development.

2.15 Conclusion

To survive in a highly competitive education environment, schools are expected to raise the quality of services they provide. Workshops should be planned and held on customer services, communication skills and personnel’s technical skills development and allocate more resources for improving educational facilities and physical environment in order to close the quality gap in education. Due to the years of segregation and apartheid education policies, the South African government had to redress the social injustices committed by the apartheid regime. The democratic government that came into power in 1994 had to steer in policies that would ensure redress and equity particularly for the previously disadvantaged and marginalized citizens of the country. Consequently, there was a dire need to design and implement new policy reform. In February 1995 the national Ministry of Education produced the White Paper on Education and Training in a Democratic South Africa. The next Chapter will focus on challenges encountered in education in an apartheid and post apartheid South Africa culminating with the theoretical frameworks to trace the construction of policy and the constitution of SKAVs in Mathematics.

CHAPTER 3
EDUCATION WITHIN A CHANGING LANDSCAPE: A SOUTH AFRICAN PERSPECTIVE

3.1 Introduction

In this chapter, the researcher reviews literature on the perspective of quality education in an apartheid and post-apartheid South Africa. Another way of describing the literature review is the researching of academic articles in keeping with the referred theoretical framework. The choice of literature reviewed was guided by the transformative agenda attached to education reform in democracy that grants various structures such as DoE and schools, to promote quality education and overcome past discrepancies. The purpose of this literature review is to present the key concepts that underpin the research study and to identify and discuss the literature pertaining to concepts regarding apartheid and post-apartheid education and the theoretical framework. A discussion of the impact of apartheid education on schools and in relation to Mathematics education is included in this. The literature reviewed therefore focuses on studies that relate to the nodes of this study namely, the DoE and schools. For many decades education, with its seemingly insurmountable challenges, has captured the public spotlight nationally and internationally. Ideally, education serves as a critical building block for society by cultivating future generations who will be able to express their individuality and creativity, thereby improving society as a whole.

This chapter highlights a complicated period that heralded the advent of a completely new and transformed system of education. The review focuses on the tensions, uncertainties and controversies in respect of apartheid education and the role of various curriculum policy reforms. An understanding of pre and post apartheid will equip South Africans and members of the international community to recognize the transformation process in the South African context. The reader is reminded that because of racial polarization in South Africa during the period under review, it is possible to come across as racially insensitive. These should be seen as within the context of the study.

3.2 Apartheid system in South Africa

This discussion will contribute to our understanding of the complex period that paved the way for the new education dispensation, and what influence it had on some education policy positions in the new South Africa. The word ‘apartheid’ means apartness (Thompson 1996: 186). The pillar of apartheid in South Africa was intended to separate non-white South Africans from a well-resourced education system that was meant for whites (Giliomee 2012: 1). Apartheid was a system of rigid racial segregation, racial classification, economic exploitation and political discrimination of non-whites in South Africa (Jansen 2014: 1). South Africa is known for its history of apartheid. In South Africa, ethnic identities have been shaped by the Population Registration Act of 1950 that classified people according to their ‘racial’ category and this classification was used to determine who had access to what resources (Ramphele 2012: 3). Classification was accomplished by means of oppressive and racist laws as well as brutal law enforcement (Cole 2010: 33). The architect of this system was Dr. H. F. Verwoerd who was Minister of Native Affairs and later Prime Minister of the then Republic of South Africa in 1960 (Jansen 2014: 2). Hendrik Verwoerd was often referred to as the “Architect of Apartheid” for his role in shaping the implementation of apartheid policy (Cole 2010: 42). South Africa comes from a past in which apartheid education was used as a tool to divide society as it constructed certain forms of identity amongst learners. (Hill 2008: 9) argued that the defining features of apartheid were of a political ideology based on racial superiority, segregation of races and distribution of resources based on racial determinants. Under apartheid education schools were divided according to race. Consequently education enhanced the divisions in society. These divisions reinforced the inequalities of an already divided society. Apartheid affected all areas of life for South Africans, and, as a result, determined which South Africans were given privileges and which ones were oppressed. The effects of apartheid were visible in all areas of life, but specifically in the areas of education, employment opportunities and places in which people lived (Hill 2008: 11).

In 1948, The Afrikaner National party won the general election and began to apply its policy of apartheid. Strategists in the National Party invented apartheid as a means to cement their control over the economic and social system. The apartheid curriculum was designed to suit the "nature and requirements of non-white people" in order to oppress the non-white population (Jansen 2014: 3). The aim was to prevent the non-white population receiving an education that would lead them to aspire to positions they would not be allowed to hold in society. Instead, non-whites were to receive an inferior education designed to provide them with skills to serve their own people in their own areas according to the Group Areas Act or to work in labouring jobs under white supervision (Evans 2010: 26). In his 1953 speech, Verwoerd remarked that it made little sense to teach Mathematics to a non-white child if he or she could not use it in a career (Giliomee 2012: 1). Thus, the wheels of apartheid gained momentum.

Kallaway (2012: 17) states that initially, the aim of apartheid was to maintain white domination while extending racial separation. Racial discrimination was institutionalized with the enactment of apartheid laws in 1948. In 1950, the Population Registration Act classified people according to their race. There were three categories, namely white, black (African) and coloured (of mixed decent) and the coloured category included major sub-groups of Indians and Asians (Evans 2010: 25). Educational inequality was also evident in funding. The Bantu Education Act of 1952 ensured that non-whites received an education that would limit educational potential and remain in the working class. The government created separate Departments of Education by race, and less money was allocated to non-white schools while most funding was allocated to Whites (Evans 2010: 28). Since funding determines quality of education, materials, facilities and teachers; disproportionate funding clearly created disparities in learning environments. Apartheid funding also affected the quality of teachers as White schools had 96% of teachers with teaching certificates, while only 15% of teachers in non-white schools were certified (Garson 2004: 1). The main problem was a lack of qualified teachers in key subjects, particularly science and Mathematics. Apartheid education aimed at keeping non-whites at the lower end of the socio-economic system. Therefore with lesser funding and lack of teachers, they did not have good quality schools.

The Apartheid system created educational inequalities through these overt racist policies (Ramphele 2012: 1). The policies and funding disparities in schools ensured contrasting access to higher education. Four Afrikaans-speaking universities and one

English-speaking university admitted only Whites, whilst the other five restricted admission and segregated classrooms (US Library of Congress 2014: 2). Additionally, there was no financial aid and banks did not approve loans to non-whites (Kallaway 2012: 23). Consequently even if learners could break through working class instruction with under-qualified teachers in overcrowded classrooms, they were still faced with financial barriers to the achievements of their academic goals.

3.3 A history of oppression and inequality in education

Historically, it can be contended that education is a political ambit. Hill (2003: 7) stated that the effects of apartheid were visible in all areas of life, but specifically in the areas of education, employment opportunities and places in which people lived. The roots of the current crisis in education can be traced to the ethnic divisions that were amplified by the apartheid colonial government that favoured a white minority group (Chisholm 2005: 191). Feelings of superiority amongst whites were enhanced while indigenous non-whites experienced feelings of ethnic inferiority, leading to tensions and resentment between the two groups (Ramphele 2012:12). Before the various reforms in education are discussed, the researcher traces the historical foundations of formal education from the 1800's by Kallaway (2012: 27) and the US Library of Congress (2014: 6). Apartheid has played a major role in the history of SA. It is important to go back to the founding years of the system in order to establish to what extent the roots of the crisis can be traced. This discussion is a broad, holistic synopsis of the main political processes that had a bearing on education, and does not claim to be an all-encompassing appraisal or narrative of the whole period. It further brings an understanding of the events of the 1800s up to the 1980s in education, in order to bring an appreciation of the transformation of the 1990s and the events that precipitated and acted as a vehicle for transformation in education.

❖ **1806 to 1899:** The earliest European schools in South Africa were established in the Cape Colony in the late seventeenth century by Dutch Reformed Church elders committed to biblical instruction to the white population, which was necessary for church confirmation.

❖ **1900 to 1947:** Following the British victory in the South African War, the

British High Commissioner for Southern Africa, Sir Alfred Milner, brought thousands of teachers from Britain, Canada, Australia, and New Zealand to instill the English language and British cultural values into South Africans. A group of Afrikaner churches proposed an education program, Christian National Education (CNE), to serve as the core of the school curriculum. The government initially refused to fund schools adopting this program. However Jan C. Smuts, the Transvaal leader who later became prime minister, was strongly committed to reconciliation between Afrikaners and English speakers.

❖ **1948 to 1973:** Before 1953, many non-white people attended schools set up by religious organizations. These schools improvised to provide schooling of almost the same quality that white children received in state schools. The non-white population in this study refers to Blacks, Coloureds and Indians - excluding the white race group. The South African government implemented an education system called CNE and the curriculum principles were based on racial inferiority**.**

❖ **1974 to 1983:** In 1974, the Minister of Education and Development issued a decree commonly known as the "Afrikaans medium decree" in which the use of both English and Afrikaans was made compulsory in non-white secondary schools. Physical science and practical subjects would be taught in English, Mathematics and social science subjects would be taught in Afrikaans, and music and cultural subjects would be taught in the learner's native language. In 1976, enforcing the Afrikaans medium decree in 1974 led to the Soweto Uprising. The act was repealed in 1979 and racially segregated education continued.

❖ **1984 to 1989:** The National Policy for General Affairs Act 76 of 1984 provided some improvements to non-white education but maintained overall separation. The Department of Education and Training was responsible for non-white education. Each of the three houses of parliament for whites, coloureds, and Indians had an education department for each race group.

❖ **1990 to 1993:** The white education system was restructured by the apartheid government in anticipation of democracy. From the beginning of 1991, white schools were referred to as Model C schools.

❖ **1994 to present day:** Segregation became unconstitutional after the introduction of the Interim Constitution in 1994, and most sections of the Education and Training Act were repealed by the South African Schools Act, 1996. Since 1994, there has been a significant redesigning process of the education and training landscape in South Africa. Eighteen racially divided departments, the dismal inheritance of the previous dispensation, had to be restructured into nine provincial departments with an over-arching national department to provide coherence of policy and philosophy (Chisholm 2005: 194).

No consultation occurred on the planning and implementation of all policies before 1994. All the definitions of culture; appropriate education content and levels; and the decisions about the purpose and outcomes of the system were controlled by the apartheid government (Chisholm 2005:196). This legislation was condemned and rejected as inferior from the time of its introduction. This policy directly affected the content of learning and further racial inequalities by preventing access to further education (Ramphele 2012:12). In addition to content, apartheid legislation affected the educational potential of students. Jansen (2004: 121) claims that its devastating personal, political and economic effects continue to be felt and wrestled with today. School was compulsory for Whites from age seven to sixteen; for Indians and Coloureds from seven to fifteen; and Blacks from age seven to thirteen (US Library of Congress 2014: 2). Clearly, the less education students received, the fewer choices they had in the working world and in accessing more education. All the aspects of appropriate education, content and levels and all the decisions about the purpose and outcomes of the system were controlled by the apartheid government. This cornerstone of apartheid ideology-in-practice wreaked havoc on the education of non-white people in SA and deprived and disadvantaged millions for decades (Cole 2010: 35). These separate Education Acts served the interests of white supremacy. It denied non-white people access to the same educational opportunities and resources enjoyed by white South Africans.

The Education Act that was passed during apartheid was one of most offensive racist laws, bringing non-white education under the control of the white government and extended apartheid to Black, Indian and Coloured schools (Ramphele 2012:12). Because of government's inequitable funding, non-white schools became impoverished. Non-white education denigrated the people's history, culture and identity (Jansen 2014). It promoted myths and racial stereotypes of white people in its curricula and textbooks. Most mission schools for Africans chose to close rather than promote apartheid in education (Cole 2010: 41). The Bantu Education Act No. 47 of 1953 was a segregation law that legalised several aspects of the apartheid system (Ramphele 2012: 12). The Indian Education Act No. 66 of 1965 was the logical extension of the Bantu Education Act of 1953 and the Coloured Persons Education Act of 1963 reinforced the policy of apartheid in a racially discriminatory curriculum administered by the various Departments of Education (Clark and Worger 2004: 48). By the end of 1964, the discrepancies in education amongst racial groups were glaring. Teacher: pupil ratios in primary schools averaged 1:18 in white schools, 1:35 in non-white schools (US Library of Congress 2014: 3). It is often argued that the policy of apartheid education was aimed at directing non-white youth to the unskilled labour market.

According to Mr. P.H.T.Nel, appointed Director of Indian Education in 1960, approximately 40 percent of all Indian teachers in employment were not fully qualified, while 10 percent of these were wholly unqualified academically, possessing not even the minimum requirements or training (US Library of Congress 2014: 7). The context of policy of inequality, served two purposes simultaneously; namely a considerable saving of money since unqualified teachers were paid less, and a deliberate lowering in the standard of education provided (Ramphele 2012: 13). In SA, school inspection has been particularly criticized because the apartheid state abused the inspection system for political reasons (Chisholm 2005: 207). It used inspectors to spy on teachers, and to report on any who appeared to be critical of the government or who were straying from the rigid curriculum (Giliomee 2012: 1). Because of this, many teachers in SA saw inspection as an illegitimate way of monitoring education (Chisholm 2005: 211). With an ever-increasing exodus of graduates and experienced teachers from education to other better employment or emigration to countries offering more attractive salaries and conditions, the incidence of unqualified teacher employment was aggravated (Ramphele 2012: 13). Learning was impoverished by the limitations that the apartheid education system has imposed up on it. Decades of social and economic discrimination against non-white South Africans left a legacy of educational inequality along racial lines. Apartheid education had devastating personal, political and economic effects that continue to be felt and wrestled with, even till today. The transformation of education can only be understood by having an insight into major role players to apartheid education legislation.

3.4 Post-apartheid system of education

Latent to Verwoerd's education policy, signaled the introduction of a brand new education system in South Africa. After 1994, a new regime removed all forms of racial privilege but non-white public schools remained in a state of crisis (Chisholm 2005: 213). All South Africans have the right to a basic education, including adult basic education and further education. According to the Bill of Rights of the country's Constitution, the state has an obligation, through reasonable measures, to progressively make this education available and accessible.

The post-apartheid government of 1994 inherited one of the most unequal societies in the world and decades of social and economic discrimination against non-white South Africans left a legacy of income inequality along racial lines (Jansen and Taylor 2003: 13). The background to this history is concisely presented by the former Minister of Education, Professor Kader Asmal (2005: 7), when he stated that “the profile of our society still reflects gross inequalities in education attainment across racial lines”. The South African government has acknowledged the crisis in the form of strategic plans, major policy conferences and statements on the part of the Department of Education (Garson: 2004: 2). In order to understand the state of education in this country, it is necessary to take cognizance of the various demographic influences that affect education in SA.

HIV/AIDS impacts on education policy reform goals in a number of ways. It diminishes participation gains that resulted from reform attempts to broaden access to primary, secondary and tertiary education given that more and more learners either pass away or leave school because of being HIV/AIDS infected or caring for family members who are HIV/AIDS affected (Giliomee 2012: 2). High infant mortality rates mean that fewer learners than expected show up for the first year of schooling (Jansen and Taylor 2003: 19) and HIV-AIDS erodes quality gains premised on the availability of trained and experienced teachers to deliver on new curriculum or assessment reforms in the sense that more and more teachers are leaving the education system because of illness or death. HIV/AIDS is also causing havoc in the country as 12.7% of all teachers had been infected with HIV/AIDS in 2004 (Giliomee 2012: 2). Giliomee (2012: 2) emphasized that the AIDS pandemic is also eroding potential economic gains from higher education delivering an increasingly skilled pool of graduates. HIV/AIDS erodes equity gains embedded in post-apartheid policy and leave the education system in disarray.

Furthermore, the prevalence of poverty in communities is often reflected in schools within these communities. Apart from many other concerns, it is true that close to half of South Africa’s schools have a shortage of classrooms. Almost 65 000 classrooms are needed; 2,3 million learners attend schools without water being available within walking distance; and 6.6 million learners attend schools without toilets (Ramphele 2012:19). Slightly more than 10% of primary schools and approximately a third of secondary schools have recreational and sports facilities (Ramphele 2012: 19). Taole (2014: 95) states that teachers do not get support from their colleagues in the teaching profession and subject specialists, due to their geographical location and inaccessibility. These role players seldom visit many rural schools. Taole (2014: 96) further emphasizes that achieving excellence in teaching and learning in rural contexts remains a challenge for teachers and other sectors of the educational change.

Since the apartheid era, many policy changes have occurred within education to try to address educational inequalities. Integration has occurred in the school system and school is compulsory till Grade 9 for all South Africans (DoE 2012: 5). Although non-white education ideology has been officially left behind, schools are still under de facto segregation (Jansen 2014: 1). Whites have moved to private schools, and suburban schools have a majority of Coloured, Indian and a few affluent Black students, while township schools are overwhelmingly Black and rural schools tend to have Black and Coloured students (Kallaway 2012: 19).

It is very difficult to address the inequalities in education without taking into account the economic disparities resulting from apartheid education. Contrasting tiers of the workforce emerged in the post apartheid's separatist presence: large populations of working class blacks stand out against the elite professional force comprised mainly of whites (Kallaway 2012: 19). This signifies that the education system needs to rely less on individual contributions from parents for compulsory education as well as higher education in order to be able to further aim at "moving past the legacy of apartheid" (Ramphele 2012: 21). The ideal reform into free public education for all and financial aid for higher education requires money. Since 20% of funds already go to education, it is crucial that the DoE explore creative reforms to reallocate funds or find resources through other avenues, e.g. tourism in townships (Evans 2010: 27). These efforts will further achieve the goal of moving beyond the past injustices towards a future of social justice. For this reason it is the assertion of this chapter that the educational policies be discussed with due regard to the people and the history that have helped to shape it.

3.5 Changing landscapes

It is only if the history of education in the apartheid years is enunciated then transformation of the education policies can be contextualized. The first democratic election for all South Africans, regardless of race, cultural barrier or colour, was held in 1994 and ended four decades of atrocious racial discrimination, termed "apartheid". The dismantling of apartheid brought with it an array of democratic changes in a nation that was ravaged by policies of racial segregation. The period since then has been the first time that the South African Government could seriously begin to educate a new generation of post-apartheid teachers. The history and origin of the South African Education system lays the foundation for constructive re-engineering of a divided society. Reversing the damage of apartheid education has been the task of the entire educational edifice. However language, curriculum and assessment have been critical as they set the goals and parameters within which teachers and administrators operate (Chisholm 2005: 201). The repression and restrictions of apartheid also weighed heavily on unions such as the South African Democratic Teachers' Union (SADTU); National Professional Teachers' Organization of South Africa (NAPTOSA) and others.

3.5.1 Impact of change on education

Immediately after the 1994 elections, the old curriculum that was designed in the apartheid era and which was inundated with racial, sexist and outdated content was replaced (Chisholm 2005: 201). The newly formulated skills policies reflected tensions and contradictions in their goals. On the one hand they hoped to compete in a global economy, while on the other they aim to attend to redress and equity (Jansen 2003: 21). SA had adopted an inclusive education policy in order to address barriers to learning in the education system (DoE 2007: 3). This raises very serious issues that apply to the teachers involved in this study. How can teachers teach a curriculum that they have never learnt, in ways they have never experienced? Many classrooms, schools and education in general, have experienced the impact of these changes in a radical or dramatic form, whether in the form of changed racial and class composition, the pressure to implement a host of new policies or to reflect new modes of conducting educational activities. These challenges have serious ramifications in the quality of teaching and learning in the South African context of education. However, the implementation of such policies was hampered by the lack of teachers' skills and knowledge in differentiating the curriculum to address a wide range of learning needs in primary and secondary phases especially in Mathematics. A paradigm shift was thus challenging to a South African educator in the sense that most currently serving teachers received their professional education and entered teaching when education was an integral part of the apartheid project and was organized in racially and ethnically divided sub-systems (Ramphele 2012: 19).

The new curricula were crucial to understand the broad parameters of social change. According to Chisholm (2005: 199) its key elements included a process of national reconciliation based on a historic compromise between old and new ruling elites accompanied by the creation of conditions for the globalization and further intensification of South African capital. The changing policies reflect the State's commitment to economic growth at the expense of access, redress and poverty alleviation for citizens long deprived of education, but little attention is paid to the implementation process (Jansen 2004: 119). There are nine provincial Departments of Education in SA that are accountable to the National Department of Basic Education (DBE). The DBE is responsible for policy formulation, and the provincial DoE's are responsible for policy mediation and implementation; service delivery; and monitoring of education districts. Studies conducted by Jansen (2004: 122) reflect that the many efforts to alter the school curriculum within post-apartheid SA have relegated the responsibility of curriculum transformation to teachers. Jansen (2004: 123) further maintains that the state has no clear understanding of the constraints and situations of teachers' daily practice.

3.6 The South African education system

Jansen (1999: 151) describes transition in education as the movement from one kind of political regime to another kind of political order. In the South African context it would mean moving away from apartheid system to a more democratic system. The Constitution and the GNU has vested substantial power in the provincial legislatures to manage their own educational affairs subject to a national policy framework. The DBE is responsible for setting norms and standards and monitoring and evaluating all levels of education (DoE 2012: 4). It also funds Higher Education Institutions (HEIs) through subsidies and by providing financial support to students through the National Student Financial Aid Scheme (NSFAS). Formal education in South Africa is categorised according to three levels (DoE 2012: 5); namely:

- ❖ **General Education and Training (GET):** consists of the Reception Year (Grade R) and schooling up to Grade 9 and the equivalent Adult Basic Education and Training (ABET) qualification. The GET (General Education and Training band) is subdivided further into phases, namely the Foundation Phase (grade 0 and grades 1 to 3); the Intermediate Phase (grades 4 to 6); and the Senior Phase (grades 7 to 9).

- ❖ **Further Education and Training (FET):** consists of grades 10 to 12 in schools and all education and training from the National Qualifications Framework (NQF) levels 2 to 4 which is equivalent to grades 10 to 12.

- ❖ **Higher Education (HE):** consists of a range of degrees, diplomas and post-doctoral degrees.

South Africa's National Qualifications Framework (NQF) recognizes three broad bands of education: General Education and Training, Further Education and Training, and Higher Education and Training. School life spans thirteen years or grades, from grade zero, (otherwise known as grade R or "reception year"), through to grade twelve or "matric" the year of matriculation. General Education and Training begins from grade R to grade nine. Under the South African Schools Act of 1996, education is compulsory for all South Africans from the age of seven (grade one) to age fifteen, or the completion of grade nine. FET is from grades ten to twelve. The national Department of Education has been split into two ministries, namely: Basic Education and Higher Education and Training. The Ministry of Basic Education focuses on primary and secondary education, as well as early childhood development centres. The Ministry of Higher Education and Training is responsible for tertiary education up to doctorate level, technical and vocational training; as well as adult basic education and training. In SA, the average ratio of learners to teachers is 32.3:1 and, public schools generally have larger classes of up to 50:1 compared to private schools (DoE 2015: 5).

3.7 Educational policy reforms and structure reforms

During the decades that were reviewed in this chapter, South Africa witnessed challenges in the field of education. In retrospect, it would appear that education was one of the most disputed terrains in South Africa. It is imperative to understand and correctly appraise the transformation that has manifested during the decades in relation to education as it is essential to reflect on the context in which South Africans lived throughout this period. Since the dawn of the democratic era in 1994, the GNU has engaged in various educational changes intended to redress the social injustices committed by the apartheid regime which used education as a tool to perpetuate its discriminatory agenda. Five curriculum changes have occurred since, initiated and facilitated by the new government of unity. Some scholars view these education reforms as “political symbols” marking the shift from the different epochs and cautioned about their later impact, since they ignored the social and cultural realities in the country (Jansen 2003: 23). The first wave of education reforms focused on the cleansing of the syllabi from the racist language and the controversial and outdated content (Jansen 2004; Chisholm 2005). According to Bantwini (2010:

87), the new curriculum instruction reflects the social values that define the new SA, namely peace, prosperity, non-sexism, non-racialism and democracy. Thus, the new curriculum fosters the universal access and common expectations for all learners. The new curriculum is synonymous of what all citizens of the new SA should know and be able to do as workers, citizens, and fulfilled individuals. The content of the new curriculum had to be non-authoritarian and be delivered in a democratic fashion. There has been a significant redesigning process of the education and training landscape in SA. Educational policies under apartheid ensure that the content and amount of education perpetuate social inequalities. Therefore changing these policies in a post-apartheid era was the logical step towards social equality (Jansen and Taylor 2003: 11). The main reason for this radical change was that policy-makers wanted to move away from the apartheid curriculum and address the laudable outcomes of skills, knowledge and values for social justice, equality and development (Spreen and Vally 2010: 421). Blade Nzimande maintains that curriculum transformation helps change society and addresses inequalities (SAPA 2011:1). A new curriculum for a new dispensation was welcomed and unavoidable. Tarvuvinga and Cross (2013: 141) emphasized that within a period of 20 years, different Ministers of Education in South Africa introduced five new curricula, namely:

- Outcomes-Based Education (OBE);
- Curriculum 2005 (C2005);
- Revised National Curriculum Statement (RNCS);
- National Curriculum Statement (NCS); and
- Curriculum and Assessment Policy Statements (CAPS).

Education policies have undergone numerous reviews and challenges over the past 20 years. In the 1990s, the White Paper on Education and Training (DoE 1995: 3); the National Education Policy Act (No. 27 of 1996); and the South African Schools Act (No. 84 of 1996) focused on addressing past imbalances in the South African system. From the early 2000s, policy reforms have focused on improving resource distribution across schools (DoE 2002: 2) and narrowing gaps in primary enrolment between the rich and the poor (DoE 2006: 2).

3.7.1 Outcomes-Based Education (OBE)

The curriculum aimed to develop the full potential of each learner as a citizen of a democratic SA (DoE 2012: 1). The South African education system has been based on what was considered a radically different approach to education, namely Outcomes Based Education (OBE). According to Chisholm (2003: 195), curriculum revision was undertaken in three mains stages or waves. The first involved the 'cleansing' of the curriculum of its racist and sexist elements in the immediate aftermath of the election; the second was the implementation of outcomes-based education; and the third stage was to review and revise OBE. However, one has to take cognizance that the diverse cultures; divergent backgrounds of learners; values in education; and extreme poverty would have a direct impact on OBE. OBE did not work as envisioned because South Africa lacks resources. There is insufficient finance allocated for training, teachers, obtaining resources, having smaller classes, discipline and more (Jansen 2004: 119). OBE is a system that flourishes in a small group context with a lot of teacher support in the form of teacher aids and administrative staff. The White Paper on Education and Training (DoE 2004: 2:) refers to the development of the individual and the capacity of individuals to become critical thinkers. It also expresses concern with challenges such as productivity, economic growth and technological advancement. The confusion and resentment that arose because of the misguided emphasis on a 'paradigm shift' were inevitable. Vandeyar and Killen (2003: 124) argue that when South Africa began its curriculum reform, the 'paradigm shift' that was so frequently advocated was, at least in relation to assessment, a misleading idea. A more productive approach to reform would have been to encourage educators at all levels in SA to adhere to a set of basic principles of teaching. The result was OBE, an approach that had already failed dismally in some First World countries. It was clear that OBE as a social experiment had failed and it was quietly shelved (Jansen 2004: 119). A critical citizenship innovation was the introduction of the new curriculum, OBE and its revision. OBE as a model was chosen to alleviate the crises in education. The new democratic government had for obvious reasons opted for transformational OBE. OBE was stressful for many teachers who felt that they were ill-prepared for this so-called paradigm shift and who found it difficult to navigate through the maze of new jargon that accompanied OBE and Curriculum 2000 (Jansen: 1999: 151; DoE 2000: 3).

3.7.2 Curriculum 2005 (C2005)

In 1997, the government launched its new education system called Curriculum 2005 which was based on OBE. According to Chisholm (2005: 201), the Report of the Ministerial Review Committee was established to review C2005 and a wide-ranging critique of the curriculum was reported. It argued that while there was overwhelming support for the principles of Curriculum 2005 which had generated a new focus on teaching and learning, implementation had been confounded by:

(i) a skewed curriculum structure and design;

(ii) lack of alignment between curriculum and assessment policy;

(iii) inadequate orientation, training and development of teachers;

(iv) learning support materials that are variable in quality, often unavailable and not sufficiently used in the classroom;

(v) policy overload and limited transfer of learning into classrooms; shortage of personnel and resources to implement and support C2005; and

(vi) inadequate recognition of curriculum as the core business of education departments.

Curriculum 2005 (C2005) policy, modeled on OBE, is largely an influence of countries such as Australia, Britain and New Zealand (Jansen 2004: 123). Jansen (2004: 123) argued that an outcomes-driven education is too technical and lacked the critical bite to quality learning. Matsidiso (2012: 309) states that the new OBE curriculum C2000 was introduced in 1997 and later amended and adapted to become C2005 when C2000 could not be implemented by 2000. Ndimande (2004: 111) mentioned that the problematic curriculum content in post-apartheid classrooms and the OBE-based C2005 assessment requirements were overwhelmingly time-consuming and often detracted from actual good learning experiences in the classroom. C2005 has been criticized as being "bogged down in too much bureaucracy, academic rationality and theoretical logic" while teachers, who are directly involved in classroom practice, have become mere observers of a process driven by outside (Mouton, Louw and Strydom 2012: 291). Thus, it could be assumed that a new approach (C2005) to education would be a useful tool for changing many obsolete approaches such as rote-learning and learning merely to pass, which were considered devoid of any holistic content. In hindsight, it seems that the newly proposed model, C2005, ironically benefited the wrong population (Mouton *et al.* 2012: 292). C2005 was reviewed and revised into the Revised National Curriculum Statement (RNCS).

3.7.3 Revised National Curriculum Statement (RNCS)

Based on the recommendations, C2005 was revised by a task team appointed by the education minister and the Revised National Curriculum Statement (RNCS) was launched in 2002. In RNCS, the administrative tasks and curriculum tools were minimized (Mouton *et al.* 2012: 299). It was tacitly acknowledged that it was practically impossible that there could be a notion such as "own pace", as initial diagnostic assessment and benchmarking for learners were essential as a point of departure (Mouton *et al.* 2012: 299). However, there were various shortcomings and many implementation problems that had to be addressed. Issues of critical pedagogy in teacher development and training are of particular importance in the enhancement and expediting of transformation (Mutemeri 2010: 81). Furthermore, government leaders, teachers and the public had lost confidence in the public schools they regulated and taught in (Ndimande 2004: 26). The Review Committee further recommended that the RNCS should reduce the curriculum design features from eight to three, namely: critical and developmental outcomes, learning outcomes and assessment standards. It should also align curriculum and assessment. The Review Committee recommended that implementation needed to be strengthened by improving teacher orientation and training, learning support materials and provincial support. It also recommended the relaxation of time frames for implementation. The RNCS was revised, which eventually led to the formulation of the National Curriculum Statement (NCS): Intermediate, GET, and FET policies that were introduced in 2003 (Chisholm 2005:201).

3.7.4 National Curriculum Statement (NCS)

The NCS is thus not a new curriculum but a streamlining and strengthening of the RNCS (DoE 2008: 3). The Council of Education Ministers agreed that the statement of the NCS should be revised in accordance with the recommendations of the Report of the Review Committee to keep intact the principles, purposes and thrust of Curriculum 2005 and affirm the commitment to outcomes-based education (DoE

2008:5). Lifelong learning through a National Curriculum Framework document was first implemented in 1996 and this was the first major curriculum statement of a democratic SA. It was informed by principles derived from the White Paper on Education and Training in 1995; the South African Qualifications Act (No. 58 of 1995); and the National Education Policy Act (No 27 of 1996). In terms of the White Paper, the need for major changes in education and training in SA were emphasized in order to normalize and transform teaching and learning. The White Paper on Education and Training (DoE 1995: 8) identifies many problems with the current system in terms of facilities, resources and the provision of quality education. It defines education as a basic human right, based on the fact that all citizens should be allowed the space to further enhance their potential capabilities that would allow them to make their full contribution to society. The White paper (DoE 1995: 17) emphasizes that the over-arching goal of policy must be to enable all individuals to value, have access to and succeed in lifelong education and training of good quality. Educational and management processes must therefore put the learners first, recognizing and building on their knowledge and experience and responding to their needs. An integrated approach to education and training will increase access, mobility and quality in the national learning system. According to Greenstein (1995: 200), the goal of education is seen as uplifting individuals so that they may contribute to the development of the economy and society which, in turn, can lead to the development of previously marginalized individuals and communities. In this sense, the emphasis is also on the development of the individual rather than just transforming the curriculum policy. The need for a shift from the traditional aims-and-objectives approach to outcomes-based education was also emphasized.

3.7.5 Curriculum and assessment policy statements (CAPS)

In 2011, the DoE introduced Curriculum and Assessment Policy Statements (CAPS) that was implemented in schools from 2012. It was a revision of the NCS. The government's newest strategy for turning education around is known as "Action Plan 2014: Towards the Realization of Schooling 2025", which aims to improve learning and the work of teachers (DoE 2014: 2). With a new curriculum at its heart, the focus is on literacy and numeracy. The new CAPS curriculum provides very specific guidelines to streamline what is taught in schools with the aim of closing the divide between well-resourced and poor schools. CAPS implementation is supported through the national educational portal and by the DoE. The increased bureaucratic accountability in SA has undermined teachers' skills, as focus is more on learners passing tests (Matsidiso 2012:3 09). In the final analysis, the importance of teacher development cannot be overstated. With the introduction of CAPS, every subject in each grade has a single, comprehensive and concise policy document that provided details on what teachers need to teach and assess on a grade and subject basis. This curriculum review had the aim of lessening the administrative load on teachers and ensuring that there was clear guidance and consistency for teachers when teaching. In post-apartheid SA, once policies are formulated, unsuspecting teachers are dispatched on a voyage of faith to implement these policies at schools (Malcolm 1999: 82). The DoE orientated hundreds of provincial and district subject advisors, for all subjects, on the changes that will be introduced so that implementation of CAPS in schools would be strengthened (DoE 2014: 4).

Drawing from the above transition in education impacts to a certain extent on the political imperatives that influenced the curriculum reform in the transition from apartheid to a post-apartheid South Africa. Given the political past and the desire to create a new curriculum in South Africa would mean to move away from the past. Taruvinga and Cross (2012: 14) argue that, in transition societies, education policy becomes a crucial arena for asserting political visions for a new society and signalling a clear break with the past. The purpose of the changes in the curriculum was mainly to lay the foundations for a single national core syllabus. In addition to the rationalization and consolidation of existing syllabi, the National Education and Training Forum curriculum developers removed overtly racist and other insensitive language from existing syllabi (DoE 2014: 4). For the first time, curriculum decisions were made in a participatory and representative manner. This curriculum is written by South Africans for South Africans who hold dear the principles and practices of democracy. It encapsulates the vision of teachers and learners who are knowledgeable and multi-faceted; sensitive to environmental issues; and able to respond to and act upon the many challenges that still confront South Africa in this twenty first century. However the policy proposals developed by the GNU had its own setbacks as Christie (2006:374) stated that such policies were flawed in its conceptualization. Such curriculum policy setbacks would impinge on the quality of teaching and learning. Reverting back to the challenging nature of the past a contemporary curriculum has to be emphasized and that the political processes that are discussed in this chapter are by no means the only political processes of the period.

3.8 Role of government in education

The GNU is committed to expanding the education system to enable greater participation of all role players in the development sphere. The education department has envisioned and prioritized quality basic education at all schools (DoE 2012: 3). A much greater focus on effective service delivery by government, as is now apparent, has resulted in the education sector being particularly tasked with achieving the outcome of quality basic education at all schools. The Bill of Rights, Section 29(3)(c) of The Constitution (Republic of South Africa 1996: 54-56) provides for quality education for all citizens. The government has the obligation to provide its citizens with the opportunity to participate fully in the socio-economic and political development of the country and to attain a decent standard of living. Provision of such opportunities is largely achieved through the expansion of access to and participation in a nation's education system. The National Education Policy (Act 27 of 1996), Section 3(4) and Section 8, mandates the Minister of Education to determine National policy for planning, monitoring and evaluation to ensure the delivery of quality education.

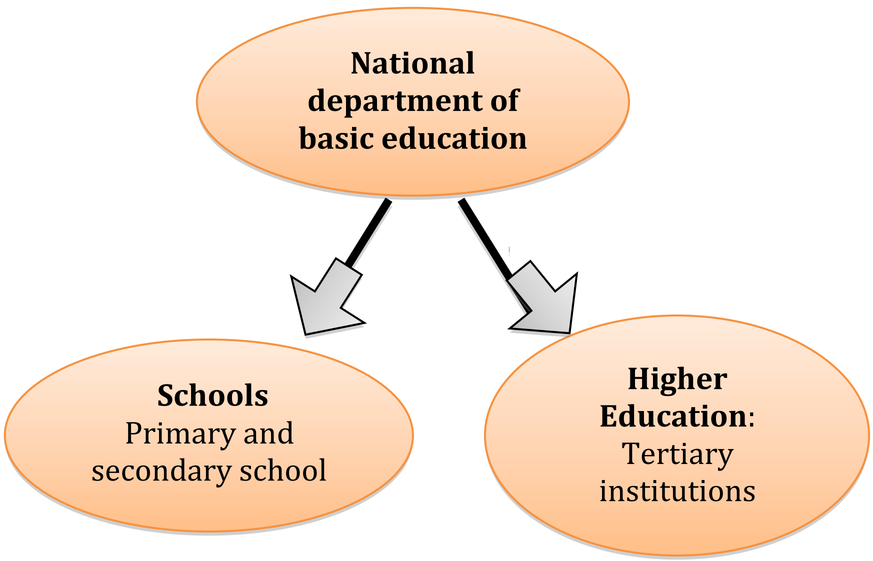
3.9 The National government departments

The National Government of South Africa comprises of Parliament, Cabinet and various Departments. These components carry out functions as outlined in the Constitution and in legislation enacted by Parliament. The various Departments that make up the national administration are charged with implementing legislation and providing services to the public. The Constitution of the Republic of South Africa, (1996) is the highest law in South Africa and no other law or government action can overrule the Constitution or be in conflict with it. South Africa's Constitution is one of the most progressive in the world and is based on the values of dignity, equality and freedom (Matsidiso 2012:3 10). The department of Basic Education is one of the forty-two national government departments that is tasked with the responsibility to ensure that the Education Policy Act is upheld (DoE 2004: 3).

3.10 The Department of Basic Education

The national department of basic education is responsible for basic education at schools from grade R, grades 1 to 12 and Higher Education Institutions (HEIs) as illustrated in Figure 3.1. Under-performing public schools that are identified by the DoE must each year prepare a plan setting out how academic performance at the school will be improved. The national department of basic education has envisioned and prioritized quality basic education at all schools (DoE 2012: 2). A much greater focus on effective service delivery by government has resulted in the education sector being particularly tasked with achieving an outcome of quality basic education at all schools.

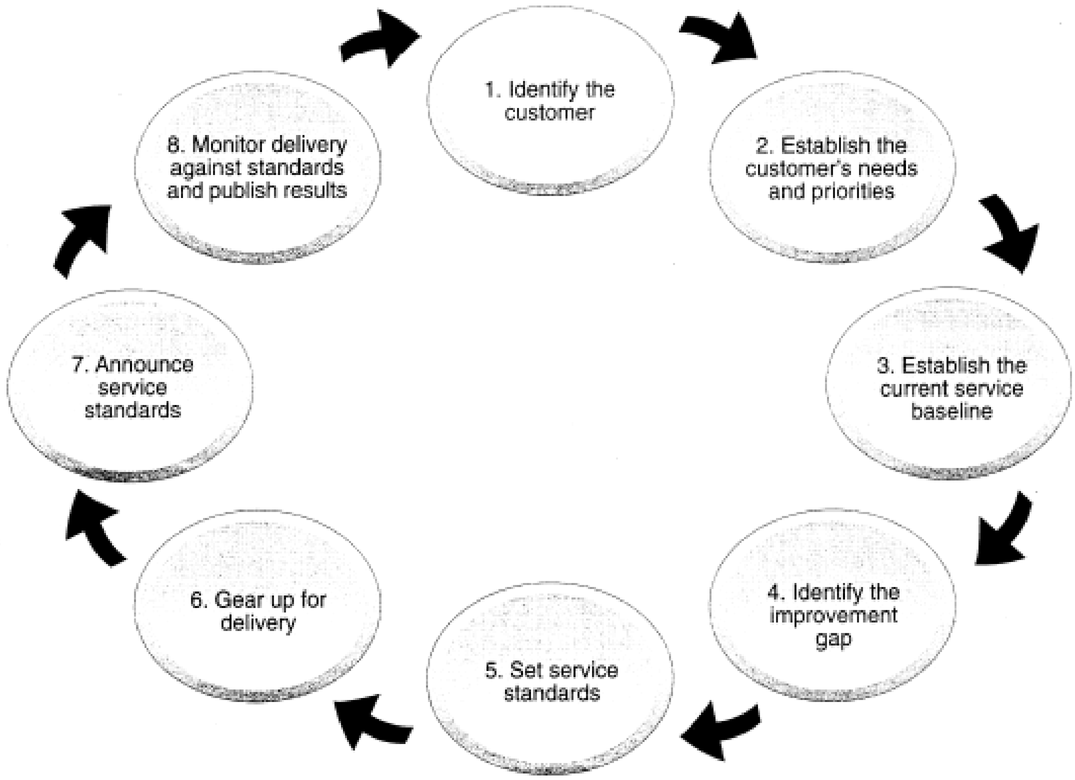
Figure 3.1: National department of basic education



Source: Self-generated by researcher

As emphasized earlier, it is enshrined in the Constitution of the Republic of South Africa and The Bill of Rights that quality education is for all citizens. The government has an obligation to provide its citizens with the opportunity to participate fully in the socio-economic and political development of the country and to attain a decent standard of living. In terms of section 196(4)(f)(i) and (iv) of the Constitution, the Public Service Commission is mandated to investigate and evaluate the application of personnel and public administration practices and advise national and provincial departments of state regarding these practices in the Public Service. The White Paper on Transforming Public Service Delivery (WPTPSD) requires all national and provincial departments to make service delivery a priority (DoE 2013: 2). It also provides a framework within which departments develop service delivery, improve strategies and improve performance by means of the setting and monitoring of services. The White Paper requires that a service delivery improvement programme be compiled and that each department has to publish a statement of Public Service Commitment (DoE 2013:3). Implementing such a programme is illustrated as an eight-step cycle, as indicated in Figure 3.2. All government departments have strategies to improve its service delivery. All schools follow the eight-step cycle to ensure that quality teaching and learning is achieved.

Figure 3.2: Eight-step cycle to improve service delivery: White Paper on transforming public service delivery



Source: Batho Pele White Paper (2013: 2)

3.11 Batho Pele Principles

The aim of the Batho Pele initiative is to get public servants to be service orientated; to strive for excellence in service delivery; and to commit themselves to continuous service delivery improvement (DoE 2013: 2). The Batho Pele White Paper focuses on improving service delivery in the educational system in South Africa. The core function of educational departments is to implement the Batho Pele Policy, and particularly, the eight Batho Pele principles listed in the WPTPSD (Republic of South Africa 2013: 21) as shown in Table 3.2 on page 96.

Table 3.1 Batho Pele Principles from WPTPSD explained

1. Consultation Citizens should be consulted about the level and quality of the public service they will receive and, wherever possible should be given a choice about services that are offered. **2. Setting Service Standards** Citizens should be told what level and quality of public services they will receive so that they are aware of what to expect. **3. Increasing Access** All citizens should have equal access to the services to which they are entitled. **4. Ensuring Courtesy** Citizens should be treated with courtesy and consideration. **5. Providing Information** Citizens should be given full, accurate information about the public services they are entitled to receive. **6. Openness and Transparency** Citizens should be told how national and provincial departments are run, how much they cost, and who is in charge. **7. Redress** If the promised standard of service is not delivered, citizens should be offered an apology, a full explanation and a speedy and effective remedy; and when complaints are made, citizens should receive a sympathetic, positive response. **8. Value for Money** Public service should be provided economically and efficiently in order to give citizens the best possible value for money.

Source: WPTPSD Government Gazette (2013: 21)

The aim of implementing this policy in educational departments is to provide an acceptable level of service as envisioned in the WPTPSD. Performance measures were developed to meet the eight steps in the WPTPSD, with the following requirements in education (Republic of South Africa 2013: 21):

- ❖ It must be aligned with policy and strategy in the curriculum.
- ❖ It must cover both processes and results. Managers must monitor whether processes are running smoothly, as well as the output of the process in terms of timeliness and quality.
- ❖ It must be broken down so that the performance can be evaluated.

Provision of such opportunities is achieved through performance measurements of all role players and national results of learners, particularly in the Annual National Assessment (ANA) for grades 3, 6, 9 and the National Senior Certificate Examination (NSC) examination results. The programmes of government thus contribute towards an enhanced quality of schooling for all. The Batho Pele White Paper (2013: 22) stipulates that the South African Public Service will be judged by its effectiveness in delivering services that meet the basic needs of all South African citizens and the principles of the Batho Pele White Paper for schools, as a definitive government regulation on quality service delivery in education.

3.12 Teaching Mathematics within a changing curriculum

With Mathematics being in dire need of improvement nationally, it is essential that quality learning and teaching in Mathematics take place at schools. As SA continues to perform poorly in international Mathematics proficiency surveys, Wits University's, Professor Rollnick (2013: 1) has pointed to the standard of teaching as part of the problem. The quality problem, or lack thereof, in the provision of education also became characterized as a capacity problem (DoE 2012: 3). In these terms, capacity often refers to qualified and experienced personnel that include teachers and central office staff at district or provincial levels. One of the national government's recent policy documents outlines a new strategy for Mathematics, science and technology education in schools with one of its major thrusts being "increasing and enhancing human resource capacity" (DoE 2012: 19). The DoE's contingency plan is to offer an "adequate supply of qualified and competent

Mathematics and science educators by upgrading under-qualified teachers and providing incentives for students to train as educators in Mathematics, science and technology" (DoE 2012: 19-20). Instructional capacity involves identifying or defining, mobilizing and activating particular sets of resources to achieve the specific goals of instruction in Mathematics within schools. The teaching profession should take a leadership role in driving pedagogical innovation and reform. There is a need for new pedagogies with a focus on 21st century skills. However, change for the sake of change is not useful. There is a need to understand its value and relevance in the context of the complexities in the South African school situation.

Vala and Talwanga (2015: 145) argue that instead of reinforcing the colleges of education which were established during the apartheid era, the new government decided to shut them down and only universities were allowed to train teachers in their faculties of education, where students register for a specific discipline and are taught pedagogy. They further emphasize that the curriculum of the specific subject Mathematics is equivalent to that of high school, to the extent that some teachers themselves are somehow limited and unable to teach the curriculum to learners. Being aware of the challenges encountered by the education system, the South African government is investing about 7% of gross domestic product (GDP) and 20% of total state expenditure to education (Kearney and Odusola 2011: 14). The Department of Education endeavours to improve the system by many other strategies which are envisaged to take the challenge, such as the re-opening of some former teacher training colleges and the intensification of workshop training for high school teachers (Kearney and Odusola 2011: 3).

In terms of qualifications locally, teachers who had completed a degree taught 60% of Mathematics learners whereas internationally, 87% of Mathematics learners are taught by teachers who have completed a degree (Reddy 2012: 1). Spaull, an education researcher at Stellenbosch University, and Professor Venkatakrishnan, the South African Numeracy Chairman at the University of Witwatersrand argued that 62 percent of Grade 6 pupils were taught Mathematics by teachers who could only manage Grade 5 work. Spaull and Venkatakrishnan (2014: 13) stated that they were unable to find evidence of any sort of existing training and professional development intervention that had helped to improve the knowledge of Mathematics teachers. Teacher content knowledge continues to impede learning in SA despite the government, universities and NGOs having provided years of training and professional development. Spaull and Venkatakrishnan (2014: 14) claim that teachers who lack an elementary understanding of the subjects they teach can actually do harm to their learners and a lack of basic content knowledge amongst teachers is a problem that should be addressed urgently. Jansen (2015: 1) revealed that matric Mathematics teachers in KwaZulu-Natal were finding difficulty with the same content their learners were expected to master. Another study by academics from the University of KwaZulu-Natal and the Durban University of Technology found that a sample of 253 KwaZulu-Natal teachers scored an average of 57% when given a matric Mathematics paper to write (Jansen 2015: 1). The existing body of evidence suggests that a large proportion of South African teachers have below-basic content knowledge in the subjects that they teach largely as a result of inadequate apartheid-era teacher training and the ineffectiveness of in-service teacher training initiatives (Spaull and Venkatakrishnan 2014: 13). Sadtu's general secretary, Maluleke (2014: 1), acknowledged that some teachers could not do Mathematics, but also emphasized that there was a shortage of specialized teachers. He also stated that Basic Education Minister, Angie Motshekga, should prioritize the opening of teacher training colleges to train teachers in specializations. In SA, not much research has been done on teacher competence, particularly content knowledge. In the United States, it was found that students taught by an effective teacher make three times as much progress than students taught by ineffective teachers (Whelan 2008:31). Khosa (2013: 21) references studies that indicate that the subject knowledge of many teachers is deficient.

The background to the education crisis is the destruction of non-white education under apartheid; the resultant: appalling teacher practice and lack of intellectual curiosity, and a dominant tradition of 'classical' schooling that spoon-feeds learners; its conception of the nature of society and the conditions under which society lives (Reynolds, Lawrence, Thorton and Smith 2013: 11). Given the grim realities of SA today, adults and older siblings in the community are now increasingly having to take a more active role in educating young learners, many of whom spend erratic periods at schools and rely on home based-care and support (Reynolds *et al.* 2013: 12). They also state that to improve the educational and parenting skills of those caring for children is increasingly a community issue and will have a critical effect on the young learners' personal and educational success in life. According to Jansen (2015: 1), improving the education of Mathematics teachers and developing teaching methods will enable learners to learn and perform better. Professional development of Mathematics teachers as well as societal, and cultural influences that impact on teachers' learning will ultimately improve their learners' learning (Spaull and Venkatakrishnan 2014: 14). Therefore, it is important to address issues such as the quality of service delivery by government and improved monitoring of the millennium development goals (MDG) achievements. Kearney and Odusola (2011: 75). Kearney and Odusola (2011: 75) further argue that there also does not seem to be a relationship between spending and MDG achievement in terms of education. There should be policies that focus on improving the quality of education services that are essential as higher spending on education services and infrastructure is not the only requirements to reach the targets; more needs to be done to improve Mathematics educational outcomes. SA needs to develop strategies to improve Mathematics and it needs to be a national priority to focus on school reform.

3.13 Impact of policy reforms

The development of a national curriculum is a major challenge and has been through numerous changes. Education is the most powerful policy tool that can shape South Africa's future and uplift its citizens. The ISS (2014: 1) claims that SA has lost almost two decades in reconfiguring an education system that was a failure in policy and implementation that contributed to the exclusion of many potential employees from a labour market that rewards good education, technical skills and entrepreneurship. Providing relevant education should be a top priority for all South Africans, as it is truly transformational and equalizes opportunity. At its broadest level, the education system and its curriculum expresses the idea of the people, society and vision in order to see the transformation through its selection of what should be in the curriculum. It represents our priorities and assumptions of what constitutes a 'good education' at its deepest level (DoE 2014: 5). The emergent effect of curriculum policy reform illuminates extensive negotiations that go into the creation of the new curriculum and the complexity of achieving a curriculum after negotiations have taken place.

The implication of a new curriculum creates not only a loss of confidence amongst teachers, but also a feeling of being overworked (SACE 2005: 26). There is no doubt about what a loss of confidence and feeling of being overworked can do to both teacher autonomy and teacher productivity. In a study on educator morale in SA conducted by Hayward (2002: 3), it was found that one of the sources of demoralization amongst teachers was overload of paperwork and administrative tasks. Another set of studies by Sikes (1992) and Fullan (2001) argues that teachers resist change that tries to move them from their comfort zones. The studies further claim that there are mitigating circumstances that lead to this resistance. Sikes (1992: 13) points out that changes which are imposed from outside threaten and can undermine the values and beliefs which make up the teachers' culture. She argues that teachers tend to lose their sense of meaning and direction; their framework of reality; and their confidence in what they do. Consequently they experience confusion and a kind of alienation. Zimmerman (2006: 15) states that some of the teachers did not receive high-quality training and now suffer insecurity and a lack confidence in their teaching abilities for the new curriculum. Zimmerman (2006: 16) also argues that the state of affairs has been aggravated by neglect on the part of their district, which includes a lack of follow-up and teacher support in the implementation of the various policy reforms.

3.14 Platform for change

Change and continuity are two sides of the same coin. As Jansen (2004: 118) explains, it is concerned with both change and continuity. Jansen (2004: 121) is of the view that the consequence of changes in higher education over the last ten years has been permanent alteration of social relationships within universities; the political relationship between government and universities; and the economic relationship between universities and their competitors. In his assessment, the continuities are strong: the profile of academic staff remains largely white and male and institutional cultures have remained more or less the same. More than two decades after apartheid was officially dismantled, most black children still experienced racial and cultural problems in the de-segregated schools of SA (Jansen 2004: 119, Ndimande 2009: 157). Many classrooms, or sites of education, have experienced the impact of these changes in a dramatic form which may be of changed racial and class composition; the pressure to implement a host of new policies; or reflect new entrepreneurial modes of conducting educational activities.

The National Center for Education Statistics (NCES 2011: 8) emphasized that Mathematics progress amongst young learners has failed to carry forward to the high school years and learners fell behind those from several other countries like Luxembourg, Hungary, Poland and Germany due to curricular problems that led to the recent lack of progress amongst high school learners. Many of the curricula still look the same in practice in the nature of educational practices and social relationships content, as well as the extent to which social class, poverty and inequality reach into and out of classrooms (Chisholm 2005: 204). Bantwini's (2010: 171) study is one example that shows the difficulties faced by teachers from under-developed countries. These teachers have different perspectives about their work and curriculum reforms and have a different set of professional developmental needs from teachers in developed countries.

According to the NCES (2011: 9) in the United States of America (USA), pursuing equity in curriculum may harm some students and evidence suggests that some past reforms have managed to harm all of them. The report also suggests that American students are heterogeneous and a rational strategy to improve Mathematics performance must begin with that premise. In SA, three-quarters of white learners complete the final year of high school but only a third of black pupils complete the final year of high school (Ndimande 2009: 126). Spaull and Kotze (2015: 15) state that of every one hundred learners who started school in 2003, only 49 reached Grade 12 in 2014 and of that number, only 37 passed - of whom only 14 qualified to go university and less than seven get the first degree in the minimum time. NCES (2011: 13) further argue that high school dropouts cost USA taxpayers billions of dollars of revenue, welfare, unemployment and crime prevention. They also found a policy reform that would implement a curricular reform more radical than tinkering with the timing of existing courses and many schools have adopted the Singapore Mathematics model, which emphasizes in-depth coverage of a limited set of topics.

In June 1996, the post-apartheid government adopted a neo-liberal economic policy known as Growth, Employment and Redistribution (GEAR). GEAR is a structural adjustment program. Gumede and Dipholo (2014: 42) recommended the complete privatization of non-essential state-owned corporations and the partial privatization of others. The entire strategy depended heavily on new investment, particularly from foreign sources pouring into SA. Pillay (2012: 1) concludes that the adoption of this neo-liberal policy was mostly about satisfying the needs of the conglomerate global economy rather than addressing the real issues of poverty and socio-economic inequalities in this nation. Fakier and Waghid (2004: 55) state that the vocabulary of OBE reflects a shift to market the language of neo-liberalism and GEAR. They further argue that this meant that SA now speaks about transformation more in terms of the market than in terms of the Reconstruction and Development Program (RDP).

More than two decades after apartheid was officially dismantled, the majority of children still experience racial and cultural problems in the de-segregated schools of South Africa (Jansen 2004: 117, Ndimande 2009: 75). Devastating personal, political and economic effects continue to be felt with today's education at schools, although the country is two decades into democracy. Learners suffer from having poor equipment at schools. Only 20% have libraries and only 7.5% actually have any books. Almost half of all schools rely on pit latrines instead of proper toilets (Ndimande 2009: 126). In July, textbooks that pupils should have received in January were found tossed into rivers in an effort to hide the failure to deliver them (Ndimande 2009: 103). The standard for teaching is low and training is inadequate (Bantwini 2010: 89). SA needs 25,000 new teachers a year but only around 10,000 qualify and Mathematics and Science teachers are in particularly short supply (Ramphele 2012: 14). The proliferation of policies in the post-apartheid era has not only resulted in confusion amongst teachers, but it has resulted in policy overload. Jansen (2014:1) argues that the non-implementation of reforms results from policy-making and planning that does not accommodate and clearly delineate the policy implementation plan. He also states that "Well-resourced schools with qualified teachers tend to land on their feet in the face of more new government policy and the rest of the schools find these policy intrusions another administrative burden to cope with." The challenge in educational policy reforms is not only to appreciate the links between education and social change over time but also to address its consequences and all its ramifications.

3.15 Current education scenario in South Africa

The chronic failures of government services are an indictment of South Africa's current situation. According to the Institute for Security Studies (ISS) (Cilliers, Schünemann, Hughes and Moyer 2015: 17), under apartheid, a role in the government was about sacrifice and risk. Today, it is a ticket for the gravy train. Jobs in national and local politics provide access to public funds and firms are eager to gain political influence. Persistent inequality is in part due to the government's failure to educate young South Africans particularly (Ramphele 2012: 1). Nokubonga Ralayo, a 20-year-old university student from Khayelitsha which is a vast black township on the edge of Cape Town, says success comes down to being able to afford a better school "It is hard to escape your background when you are growing up," she says (Ramphele 2012: 6).

According to the World Economic Forum, only 15% of South African children can read and write at the minimally prescribed levels by the age of 12. The ISS report (Schünemann *et al.* 2015: 21) claims that for someone from rural South Africa, who has a poor education and little chance of getting a good job, a seat on the local council may be the only way out of poverty. Townships are characterized by poverty, extremely high unemployment rates and a lack of social infra-structure including providing adequate educational, health, housing, recreational and transport facilities (Govender and Killian 2010:15). President Zuma used R246 million of taxpayers` money to fund extravagant upgrades to his private homestead in Nkandla, an amount that could have provided 3 600 families with low-cost housing or paid the salaries of thousands of teachers, doctors and social workers (ISS report, Cilliers *et al.* 2015: 23). They also state that his complete lack of shame over such blatant extravagance suggests he is unlikely to act in the interest of the country any time soon and it is undeniable that the country is currently in an economic and political decline, which has a direct impact on education. Jansen (2014:1) states "Through a combination of legacy, neglect and bad policy decisions, our educational institutions are in a worse state than before". He emphasized that seven mistakes impacted negatively on education, namely: OBE; voluntary severance packages offered to teachers; closing teacher education colleges; mergers of some universities that made no sense; mergers of universities with technikons; neglect of mother-tongue instruction; especially in township schools; and the failure to prescribe basic minimum standards for school education which were legally enforceable. Jansen (2014: 1) states that the main problem is that despite many reforms affecting the school system since 1994. SA has not yet had a game-changing intervention that alters the essential character of dysfunctionality in the majority of schools, nor has improved the life chances of most learners. Jansen (2014: 5) further stated that the Department of Basic Education (DBE) had wasted hundreds of millions of rands on new curricula, systems and policies. Ndimande (2009: 130) and Bantwini (2010: 169) agree that the former privileged schools are now de-racialised and have widened the gap between themselves and the mass of poor schools as a result of government policies seeking energetically to correct the wrongs of the past. These are some of the principal reasons for the inability of the education system to make discernible progress in the fight against apartheid and quality education. Jansen (2015: 13) emphasizes that in ultimately having top academics, it is imperative to make sure that preparation begins at school.

The researcher explicated the challenge in searching for a theoretical framework that allows for the tracing of curriculum policy reform. These associations under apartheid brought about tension, uncertainties and controversies.

3.16 Theoretical framework

The search for a theoretical perspective to trace the construction of policy and the constitution of skills, knowledge, attitudes and values (SKAV) in practice was a challenge. To address the aspect for a theoretical framework for this focus of study, the theoretical framework guided the data analysis. The theoretical framework could be deployed for four processes, namely:

- To approach curricula policy reform in terms of a networked activity;
- To trace how policy is constructed and disseminated in practice;
- For teachers to account for their actions in implementing curricula policy reforms; and
- To trace if transition from primary to secondary school Maths is consistent.

It is necessary to unveil the theoretical implications since they are indispensable in tracing apartheid and post-apartheid education. In light of the above, the following theoretical frameworks were considered: Business Process Reengineering (BPR), (Davenport and Short 1990), concept of capacity for instruction theory (Engelmann and Carnine 1991; King and Newman 2000); Theory of Self-efficacy (Bandura 1986); and Activity Theory (Vygotsky 1981, Nardi 1996, Engestorm 1987 and Leont'ev 1979).

3.16.1 Business Process Re-engineering

Business Process Re-engineering (BPR) is the analysis and design of workflows and processes within and between organizations (Davenport and Short 1990: 13). According to Kvavik, Goldstein and Voloudakis (2008: 1), education institutions have invested heavily in BPR to improve services and reduce costs. This interest in re-thinking processes and procedures is driven mainly by budget shortfalls, information technology infusion and external pressures for greater accountability and responsiveness. Despite this enthusiasm and investment from education institutions, few studies have examined the overall effectiveness and outcomes of re-engineered processes. By injecting new ways of doing things, BPR provides the opportunity to reshape the culture of teaching and learning in Mathematics, as reflected in its values, norms, guidelines and expectations in the CAPS documents which was introduced up to Grade 11 in 2013. Grade 12 began with CAPS in 2014. The BPR perspective can be designed around a framework which has three main sources, namely: a retrospective analysis of our own experience in re-engineering several internal processes such as development program management (Abdous 2005: 1); a syllabus creation process (Abdous and He 2006: 122); and learning assessment. The framework provides a well-grounded tool to use in the re-engineering processes in Mathematics. Hengst and de Vreede (2004: 87) describe the phases of the framework that also have a direct bearing on the CAPS document as outlined by the DoE (2012: 3) as follows:

- **Initiation** - This is the first phase that is aimed at identifying and understanding the purpose, rationale and the objectives of the process review (PR). This phase requires an understanding of the dynamics and the risks associated with the proposed reengineering process in CAPS;
- **Analysis** - This second phase involves an in-depth analysis of the process tasks and procedures by analyzing the new CAPS curriculum, reviewing risks and assumptions and by identifying potential causes of resistance. A presentation of the existing practices is not only critical to mapping the core problems and procedures of the process, but is also foundational for the re-engineering process itself.
- **Re-engineering** - This third phase is intended to suggest features and functionalities. The new CAPS document in Mathematics includes active participation and feedback from all appropriate role players.
- **Implementation and evaluation** - The implementation and evaluation phase is intended as a step towards the suggested re-engineered process, thus addressing users' and stakeholders' issues and concerns.

3.18.2 Conception of capacity for instruction

Engelmann's and Carnine's (1991: 23) main interest is not in dividing learners into categories for sorting purposes. Their main interest is in developing instruction that will achieve faultless communication with all learners. Engelmann's and Carnine's (1991: 25) further emphasize that in the real world of teaching, even when the instruction is logically faultless, it does not always achieve the anticipated results. Instruction that has been designed to be faultless it may fail for a particular child. Engelmann and Carnine's (1991: 31) state that because the instruction is the same for all learners, it can be ruled out that instructional factors account for observed differences in learning and therefore, each learner's response to the instruction provides precise information about the learner. This analysis is similar to the logic of "standardized tests" where the test and the testing conditions are held constant and the responses of the examinees are allowed to show variation.

The concept of capacity for instruction as a theoretical framework constitutes bringing together, in a dynamic way, the investigations of classroom processes and school wide organizational resources and arrangements that promote quality instruction and learning in Mathematics. Loyiso, Thembi and Sibusiso, (2006: 6) state that many schools in SA struggle to offer high quality instruction in Mathematics. They further argue that many schools continue to fail in their quest to improve the teaching and learning of Mathematics. At the theoretical and conceptual level, the notion of instructional capacity has received increasing attention amongst several educational researchers, especially policy researchers in North America (Cohen and Ball 1999: 31). According to King and Newman (2000: 579), the theory capacity for instruction is a school's capacity which includes five key dimensions that are likely to shape instruction and learning in schools, namely: individual teachers; instructional culture of the school; instructional programmes at the school; nature of the instructional leadership of the school principal; and the quality and quantity of technical and/or material resources for teaching and learning.

These dimensions of capacity begin to define what is called the capacity for quality instruction inventory, that is the ability of a school to offer high quality instruction and/or foster quality learning for all learners in specific subjects. This ability to offer high quality instruction in a subject area is determined by the above five key dimensions. Loyiso *et al.* (2006: 17) emphasize that instructional capacity involves identifying or defining, mobilizing and activating particular sets of resources to achieve the specific goals of instruction in a subject area within the school and such resources as staffing levels, instructional time, class size and material resources that impact on the teaching of Mathematics in a school. On the analysis of capacity, Loyiso *et al.* (2006: 18) consider leadership as a key component of the schools' inventory for quality instruction.

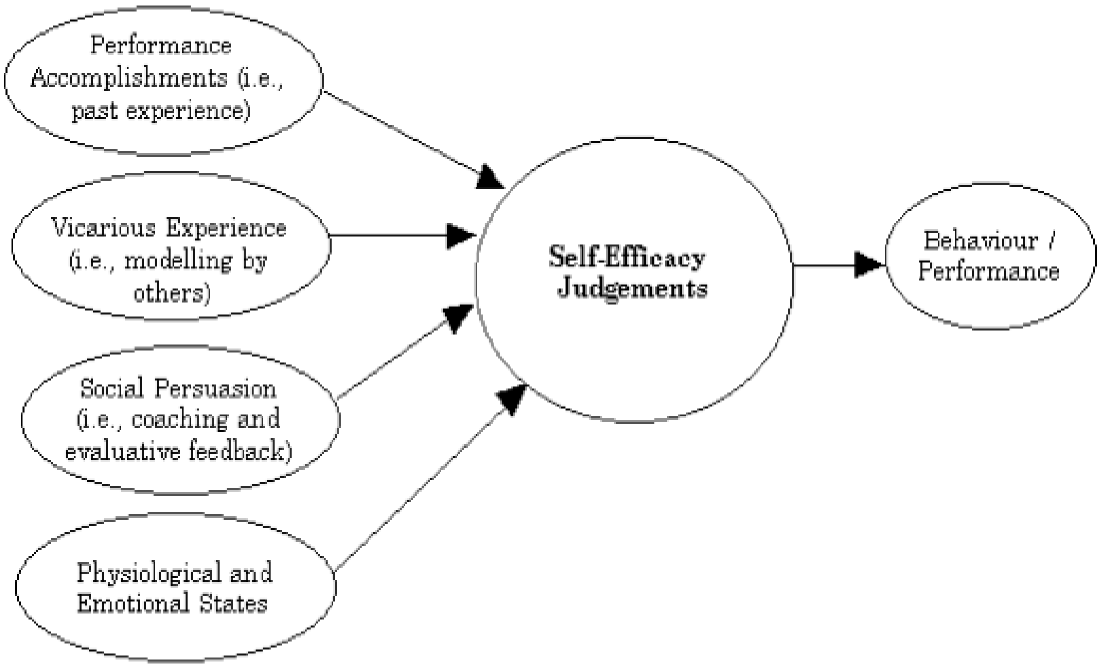
Teachers and other staff members constitute one important dimension of a school's capacity for instruction. It is the intellectual ability, knowledge and skills of the individuals involved in the teaching and learning tasks that impact on job performance and effectiveness in the classroom (King *et al.* 2000: 577). The subject matter competence of teachers and its possible impact on the poor state of teaching and learning in Mathematics also impact on teaching and learning (Loyiso *et al.* 2006: 21). This way of focusing on the resources for instruction and their related interactions is informed by the work of Cohen *et al.* (2011:71) whose framework provides the necessary links between capacity and classroom instruction. The central argument in Cohen *et al.* (2011:83) is that instruction begins with and involves interactions amongst three components, namely: the teacher; the students; and the materials, both physical and intellectual materials, that is the instructional unit. Loyiso *et al.* (2006: 21) and Cohen *et al*. (2011: 84) argue that schools often differ from each other based on the quality and coherence of their instructional programmes and the analysis of capacity thus considers leadership as a key component of the schools' inventory for quality instruction.

3.16.3 Theory of Self-efficacy

Another theoretical framework underpinning this research study is Bandura's (1986) theory of Self-efficacy. Bandura (1986: 5) introduced a theory of Social Learning which directly involves the goals that learners pursue. The theory of Self-efficacy is based upon the positive relationship between mathematical achievement and attitudes found in learners. There is a need for strong teacher content knowledge in the teaching efficacy theory (Bandura, 1986: 21) which found that teacher efficacy can be sub-divided into a teacher's belief in his or her ability to teach well and his or her belief in a learner's capacity to learn well from the teacher. Bontis, Hardie and Serenko (2009: 189) argue that, like teacher attitudes, teacher efficacy is a strong indicator of quality teaching. Bandura's (1986: 21) basic principle is that learners are likely to engage in activities to the extent that they perceive themselves to be competent in those activities. With regard to Mathematics, this means that learners will be more likely to attempt, persevere and to be successful at tasks for which they have a sense of efficacy. Teaching efficacy, as described by Bandura (1986: 23), is the teachers' beliefs in their personal efficacy to motivate and promote teaching and learning that affects the type of learning environments they create and the level of academic progress their learners achieve. An individual's self-efficacy will influence the amount of effort, persistence and resilience they will invest in the face of obstacles (Bandura 1986; Schunk 2011). Likewise, a teacher's instructional efficacy will influence his or her teaching practices.

According to Bandura's theory (1986: 26), there are four sources of information that people base their efficacy judgments on, namely: performance outcomes, vicarious experiences, verbal persuasion and physiological feedback. The four components illustrated in Figure 3.6 are based on Bandura's (1986: 27) theory of Self-efficacy, whereby it helps one decide whether or not one thinks they can accomplish certain tasks.

Figure 3.3: Sources of Self-efficacy Information



Source: Bandura's theory (1986: 26)

Bandura's (1986: 31) theory highlights performance outcomes as most effective when compared to the other outcomes, namely:

❖ Performance Outcomes

Positive and negative experiences can influence the ability for one to perform at a given task. If one has performed well at a task previously, one is more likely to feel competent and perform well. For example, if one performed well in a Mathematics class, one is more likely to feel confident and have high Self-efficacy in another Mathematics class. Self-efficacy will now be high in that given area and since they have a high self-efficacy, teachers are more likely to teach better and learners complete the task with much better results, as opposed to a class they may not perform well in and have a low self-efficacy in.

- ❖ **Vicarious Experiences**

Vicarious experiences refer to a person using other people's experiences and comparing them to their own task. If a person sees someone similiar to them succeed, it can increase self-efficacy. However, the opposite is also true and seeing someone similar to you fail can lower self-efficacy. An example of how vicarious experiences can increase self-efficacy in the teaching process is through mentoring.

- ❖ **Verbal Persuasion**

Using verbal persuasion in a positive manner leads an individual to employ more effort and therefore have a greater chance of succeeding. Also, verbal persuasion effectiveness is directly influenced by the level of credibility where the more credibility, the greater the influence for greater value.

- ❖ **Physiological Feedback**

This source is the least influential of the four. It is important to note that if one is more at ease with the task at hand they will feel more capable and have feelings of high self -efficacy. When faced with a difficult task, people who have high self-efficacy will face the challenge as something to be learned and mastered. While striving to complete a challenging task in Mathematics, learners with high self-efficacy may face failures or setbacks, but they will not give up.

3.16.4 Human Capital Theory

Livingstone (1999: 9) postulates human capital theory as peoples' learning capacities are being comparable to other natural resources involved in the production process. When the resource is effectively exploited the results are profitable both for the enterprise and for society as a whole. Livingstone (1999: 9) further argues that human capital theory tends to equate workers' knowledge levels with their levels of formal schooling, to rely on quantitative indices of the amount of schooling in estimating individual economic returns to learning and to infer that more schooling would lead to higher productivity and macroeconomic growth. Human capital theory posits that improving individual educational attributes will lead to economic growth (Chisholm 2005: 197). Therefore, the emphasis is on quality schooling that leads to earned incomes in advanced industrial market economies, which lent support to this perspective and encouraged the view that more schooling would inevitably lead to economic success.

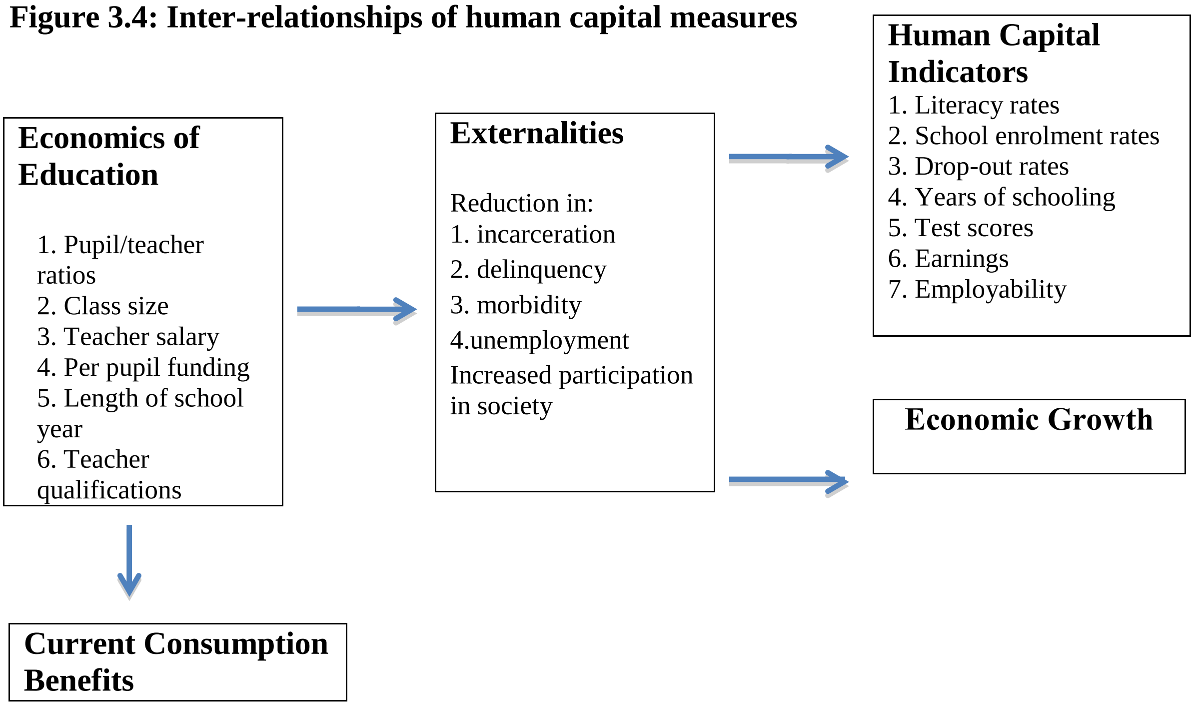
Human capital theory indicates that the quality of schooling is now the problem and that by raising standards, starting earlier or providing more relevant or specialized forms, both human capital creation and economic growth can be rejuvenated. Livingstone (1999: 10) advocates that human capital suggests that great increases in learning efforts have not led to economic gains because of the declining quality of education with regard to the schooling of young people. The claim is made in terms of falling performance levels on standardized tests such as TIMSS tests, ANA and the NSC examination. The curricula and pedagogies of current educational systems are changing and education departments should continue to try to improve them in order to bring about economic growth. Livingstone (1999: 11) begins to draw greater attention to aspects of learning previously ignored or taken for granted by human capital theory's fixation on schooling and credentialed knowledge, namely the cumulative bodies of tacit knowledge. He also reiterates that there has generally been a high correlation between people's level of formal schooling and their participation in continuing education.

Christie (1997: 119) postulates that the formulation of an education-economy link bears the hallmarks of human capital theory, which asserts that education brings returns for both individuals and society more broadly and that education is linked to productivity. Human capital analysts could take this strong association as a warrant to rely on school attainment as a sufficient indicator of adult learning efforts. Both Becker (1964: 13) and Bowles (2007: 329) appear to agree that education enhances worker productivity. On the topic of schooling and compulsory education, Bowles (2007: 338) and Becker (1964: 15) provide two similar views. Bowles (2007: 341) transfers his ideas of class and class struggle into education, where as Becker (1964: 15) stays within the realm of his traditional views of education in a capitalist society and its ability to improve the human condition. Bowles (2007: 341) believed that modern human capital theory brought basic social institutions such as schooling, previously relegated to the purely cultural and super structural spheres, into the realm of economic analysis. Becker (1964: 19) asserts that every worker is a capitalist, acting in his or her own best interest. He has also expanded human capital theory with his research on the relationship between earnings and the return on education. Bowles (2007: 345), in his critique of human capital theory, supposes that education, training, child rearing and health care perform a dual economic function in the production and perpetuation of the social order. In other words, the reproduction of capitalist class structure is assured through quality education and training. Bowles (2007: 346) and Becker (1964: 23) conclude that both economists view education and schooling as an investment in that it raises individual earnings potential. Becker (1964) and Bowles (2007) emphasize the future of workforce education because the current system of compulsory education does not appear to be working. Bowles (2007) theory, in particular, seems to touch on the reasons for inefficiencies in modern educational systems. A comprehensive study of both Bowles' (2007) and Becker's (1964) work may create a path to a new educational system that will reinforce and maintain the economic status in the new global knowledge-driven economy.

Becker (1964: 41) suggests that education raises the productivity of workers by imparting useful knowledge and skills. Spence (1973: 359) argues that education is used as a market signal to indicate the potential productivity of workers where they may have accumulated significant SKAV through formal schooling. Researchers Stroombergen, Rose and Nana (2002: 10) attempt to estimate the effect of quality education on learners' human capital outcomes by typically using measures of resources as a substitute for the unobservable 'quality' variable. They argue that measures of resources usually include pupil - teacher ratios, class size, teacher salary and per-pupil funding. As Catterall (1997: 297) states: "We know that the mere presence of resources – a teacher with certain skills, a given set of curriculum materials, a student-teacher ratio - does not an educational process make, no more than does a plateful of ingredients lead unmistakably to a soufflé". From a policy point of view, using such proxies for quality might be desirable as policy-makers would like to know the effect of the resources that they can control. However, these measures probably do not do justice to the complexity of the educational process.

Human capital is also defined as the sum of discounted earnings, as the earnings of labour are the major component of GDP (Stroombergen *et al.* 2002: 17). The argument is that the higher earnings of educated workers simply reflect their superior ability acquired during the process of education, rather than through skills and knowledge from experience only. According to Stroombergen *et al.* (2002: 11), three main areas to which measures of human capital have been applied are employability, economic growth and economics of education. The inter-relationships may be represented as illustrated in Figure 3.7.

Figure 3.4: Inter-relationships of human capital measures



Source: Stroombergen *et al.* 2002: 11

Stroombergen *et al.* (2002: 12) argue that these areas are not independent of each other. They interpret economic growth in a wide sense as the ever-increasing ability of the economy to improve the economic, social and environmental welfare of its citizens. Rather than bemoaning the decline from an impoverished and unfair past or becoming fixated on international league tables of current Mathematics scores, the focus should be on quality education. Researchers who attempt to estimate the effect of the quality of education on students' human capital outcomes typically use measures of resources as a substitute for the unobservable 'quality' variable. As employers generally look for more than academic ability, formal education is used as a device about potential employees' broader human capital and therefore suitability for the job. This theory is consistent with the use by many employers of other pre-employment screening mechanisms such as aptitude tests. However, there is a return on education in the form of higher earnings and employability. If education enhances welfare by increasing human capital, governments and individuals will want to know how much to invest in education and what forms this investment should take. What is desired? Do formal schooling and educational resources generate a measure of human capital? What needs to be considered is the effect of the quality of education on learners' human capital outcomes and future incomes.

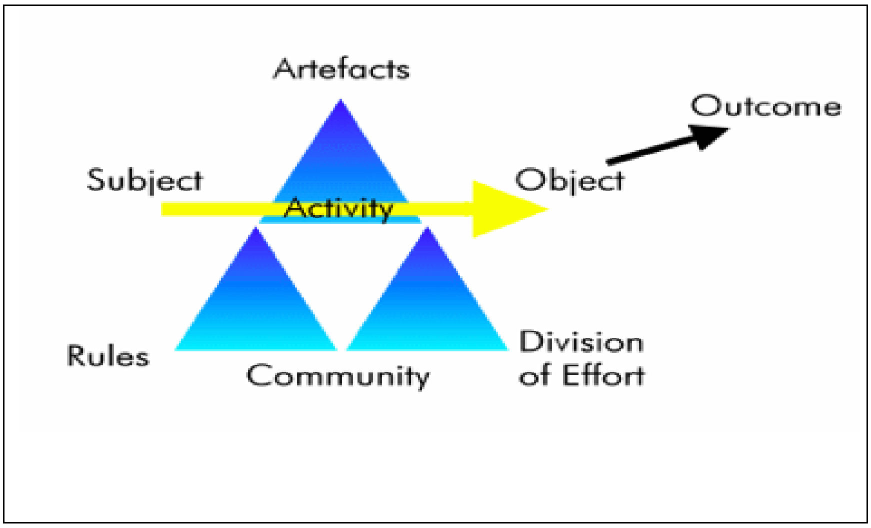
3.16.5 Activity Theory

In the activity theory the basic unit of analysis is an activity (Vygotsky 1981 and Engestorm 1999). An examination of the activity theory shows that the role of context in understanding the activity is crucial since all activity is shaped by the context within which it occurs (Bertelsen and Bodker 2003: 7). It is argued that the unit of analysis is motivated activity directed at an object which is goal driven (Bertelsen and Bodker 2003: 7). It includes cultural and technical mediation of human activity in which activities consist of goal-directed actions that are conscious. Figure 3.8 illustrates Engestorm's (1999: 1) different levels of motivations that guide the users' actions, i.e. the object, the desired outcome and the artifact motivations.

The concepts in Figure 3.5 can be made operational by asking, the following questions: What does one want to achieve with an artifact? Which basic need does one want to gratify? Why does one use a specific artifact to guide him/her to the object and desired outcome? Engestrom's (1999: 1) model is useful for understanding how a wide range of factors work together to impact an activity. In order to reach an outcome, it is necessary to produce certain objects like experiences, knowledge and physical products.

Artefacts like tools used and documents mediate human activity. An organization or community also mediates activity. The community may impose rules that affect activity. The subject works as part of the community to achieve the object. An activity usually features a division of labour. Its constituents of activity are not fixed and can dynamically change. Therefore, it could be used to trace policy constitution and translation since policy traverses the three nodes of the study.

Figure 3.5: Activity system at individual levels



Source: Engeström 1999: 1

The transformative agenda attached to educational reform in SA by the state granted the DoE, schools and industry growth opportunity. These structures aid in human resources development and overcoming skills shortages. Furthermore, this transformative agenda also identified what will be trialed in this study, namely the CAPS Mathematics Policy that traverses the nodes of this study. Within each node, there are many others that drive and move these nodes to deliver the CAPS Mathematics Policy. For example, at the DoE node are subject advisors and at the school node are Mathematics teachers in the primary and secondary schools. Their association with CAPS Mathematics policy identifies communities within the nodes. According to Engestorm (1999: 2), an activity system should not be considered as an isolated, static entity as its balance might be challenged by different kinds of contradictions. Contradictions might occur within an activity system. For instance, the object might not be transformed in the desired outcomes. The needs of users might change, which causes them to desire different outcomes and therefore they want to achieve different objects. An artifact might not function in the way it is expected to work. This implies a relational interaction amongst the different personnel in a network, and means the interconnections amongst various role players are brought to the fore. For example, the CAPS Mathematics curriculum is formulated at the DoE node but is implemented at the school node. In this way, the DoE node is connected to the school node. The school nodes enroll learners with SKAV and many of the learners then enter the world of work after receiving education. This means that the DoE node is linked to the school node. In this way, the subject is connected to community which is then connected to the object. Firstly, each activity is directed towards an unconscious object and a desired outcome that motivates the activity. Bertelsen and Bodker (2003: 8) state that users gratify their needs by achieving the object and transforming it into the desired outcome. Secondly, each activity is executed by a number of actions that are guided by conscious goals. If all the required actions are completed, this might result in the completion of the activity or the attainment of the desired outcome. Finally, the actions in their turn are carried out by several unconscious operations that are triggered by the conditions in a specific context. It should be noted that this hierarchy cannot be considered as static as for instance actions turn in operations and vice versa as a result of the experiences users have in their context (Bertelsen and Bodker 2003: 293).

Consequently, the relationships developed within the network shape and reshape and define the characteristics of these structures. Therefore, they would affect each other in a complex web of interconnections that involve a process of mutual shaping. Problems may occur when the principal structure defines the nature of the problem and proposes a way forward. For example, the post-apartheid Government identifies the backlog created by apartheid in respect of human resources development, poverty, job opportunities, redress and equity and proposes to use education as a leverage for human resources development. The national DBE expects the provincial DoE to train teachers and teachers are expected to implement the new curriculum at schools. There are ways in which others will relate to one another within the network, for example the DBE defines the role of the subject advisor and subject advisors are expected to workshop teachers to implement the CAPS Mathematics policy. During mobilization, the network begins to operate to implement the proposed solution and then subject advisors mobilize teachers to focus on standardized tests such as ANA and NSC examinations. The proliferation of policies in the post-apartheid era has not only resulted in confusion amongst teachers but has also resulted in policy overload. The implication of this is not only a loss of confidence amongst teachers but also being inundated. There is no doubt what a loss of confidence and feeling of being overworked can do to both teacher autonomy and teacher productivity.

3.17 Conclusion

The review of literature on the quality interface between primary and secondary phase Mathematics of teaching and learning as discussed helped the researcher in reaching important specific goals, *inter alia*:

- ❖ To give an in-depth understanding of the theoretical framework of the research;
- ❖ To explicate the challenge in searching for a theoretical framework that allows for the tracing of policies through the different mediums;
- ❖ To identify gaps in knowledge, as well as weaknesses in previous studies;
- ❖ To discover connections, analogies or other relations between different research results by comparing various investigations; and
- ❖ To identify variables that must be considered in the research, as well as those that must prove irrelevant.

The literature review in this chapter provided the researcher with the means of getting to the frontier in this particular field of knowledge. Literature on quality policy reforms in Mathematics formed the basis of the literature in the researcher's study by traversing these steps from apartheid to the democratic country of SA. In the formulation of various education policies, the government ascertained whether the policy was viable in a new democracy and whether the policies were implementable. The history of education in the apartheid years was enunciated then the transformation of education policies was contextualized. The researcher made the reader aware that because of racial polarization in South Africa during the period under review, it is possible to come across as racially insensitive; but these should be seen as within the context of the study and the Mathematics results. The next Chapter focuses on the methodology used in this research study.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

Chapter four focuses on the research design that was adopted for this study. The design is discussed and justified, revolving around the research paradigm and the data collection practices. The research methodology and the data analysis procedures are also explained. Validity, reliability and ethical issues are elucidated as they apply to this study. The research design chosen for this study is the pragmatic approach, in which both qualitative and quantitative methods are applied. Similar studies are usually only quantitative in nature and they are criticized for being too narrow in their focus. It is also the researcher's belief that using both methods will complement each method's strengths. This chapter demonstrates how the use of qualitative and quantitative methods show associations as they traverse from DoE to teachers and then to learners from primary to secondary phases. The present study evaluates 8 primary and 12 secondary schools in KwaZulu-Natal. The researcher will collate the quantitative and qualitative data from learners. The population of the participants is representative of a cross section of the race groups in KwaZulu-Natal. Cohen *et al.* (2011: 27) state that it is from the different data that rich information emerges. The choice of a questionnaire format was decided upon because some questions are designed to elicit fixed responses from respondents, while the others are designed to give respondents freedom to express themselves. The following are salient aspects of the design of the project which will then be contextualized in detail:

- A mixed-methods approach is adopted in this study,
- The research instrument used in the quantitative study is a questionnaire based on the modified SERVQUAL instrument,
- The qualitative approach in the form of focus group interviews with the secondary school learners who indicate that they are willing to participate and individual educators and
- Document analysis from written documents, reports, policy documents, national and international Mathematics results.

4.2 Research paradigm

The research paradigm is the use of a mixed-methods approach. Mixed-methods involve both qualitative and quantitative study. However, Creswell (2012: 15) observed the development of the pragmatic approach in which the qualitative and quantitative paradigms are mixed. Selection of the ideal research paradigm serves as a crucial point of reference for a study. How the world is viewed from an academic point of view is generally referred to as a paradigm (Denzin and Lincoln 2011: 13).

At the schools node, the Mathematics teachers' questionnaire also included open and closed ended questions focusing on quality (see Appendix, Annexure F, p. 301 and Annexure H, p. 309). These questionnaire and interviews were used to answer these research questions: *To ascertain the perceptions and expectations of primary and secondary school educators regarding the preparation of learners in Mathematics from primary to secondary school; to investigate the readiness of learners in Mathematics for the secondary phase, to establish learners' perceptions, expectations and experiences of Mathematics at primary school level in preparing them for secondary school Mathematics; to determine learners' perceptions, expectations and experiences of Mathematics at secondary school level*. In comparison to quantitative research, qualitative inquiry employs different philosophical assumptions; strategies of inquiry; and methods of data collection, analysis and interpretation (Creswell 2012: 173) is the use of existing administrative records and statistics to answer these research questions: *to examine the extent to which the primary and secondary phase Mathematics results in the Annual National Assessment (ANA) and the National Senior Certificate (NSC) impact on quality teaching and learning in Mathematics as reported by the Department of Basic Education (DBE).* Data were analyzed from the teachers' questionnaires and interviews to answer research question: *To explore whether gaps exist between primary and secondary phase Mathematics and how is policy constructed and translated in practice as it traverses from the DoE to schools?*

The data obtained at the school node from the educators is multi-faceted to trace the trajectory of policy, construction of policy and constitution of SKAV. The multi-faceted data revealed how policy is in practice and allow the emergent effect of policy that is cascaded from DBE to all primary and secondary school educators. The research design is organized to focus on the issues of gaining access pertaining to the research questions and how data are captured and steps taken during analysis of data.

Crabtree and Miller (1999: 12) describe a paradigm as representing a patterned set of assumptions concerning reality (ontology); knowledge of that reality (epistemology); and the particular ways for knowing that reality (methodology). Guba and Lincoln (2010: 105) state that a researcher working within a paradigm must demonstrate congruence between the ontological question: what is the form and nature of reality?; the epistemological question, what is the nature of the relationship between the knower and what can be known?; and the methodological question: how can the researcher find out about the nature of reality? (Refer to Table 4.1). Quantitative and qualitative research design addresses important issues relating to a research project (Sekaran and Bougie 2010: 17). Qualitative researchers are interested in understanding the meaning people have constructed, that is, how people make sense of their world and the experiences they have in the world (Merriam 2009: 13). Others emphasize an epistemological stance whereby: qualitative research is research using methods such as participant observation or case studies which result in a narrative, descriptive account of a setting or practice (Parkinson and Drislane 2011: 4). Epistemology is about "how we know what we know" (Crotty 1998: 8) or "the nature of the relationship between the knower or would-be knower and what can be known" (Guba and Lincoln 2010: 193). Guba and Lincoln (2010: 193) also state that epistemology is concerned with providing a philosophical grounding for deciding what kinds of knowledge are possible and how we ensure it is adequate and legitimate. It is related to ontology, "the study of being" (Crotty 1998: 10) or "The nature of reality" (Guba and Lincoln 2010: 197).

4.2.1 Quantitative Research

Henn, Weinstein and Foard (2006: 23) state that quantitative research predominantly assumes a positivist worldview called paradigms and is tied to research techniques. A quantitative research paradigm emphasizes the importance of generalizability and reliability (Henn *et al.* 2006: 25). In this study, data will be collected using questionnaires and interviews. The research instrument used was a questionnaire which is a set of systematically structured questions used by the to obtain important information from respondents regarding salient information about the teaching and learning of Mathematics in a changing curriculum. As an important research instrument and a tool for data collection, a questionnaire has as its main function measurement (Oppenheim 1992: 100). It is the main data collection method in surveys and yields to quantitative data. Open-ended questions were included for anticipating factual responses that included the respondents' experiences and past activities in teaching Mathematics; his or her details; and the impact of curriculum reform in the teaching of Mathematics at primary and secondary schools. Dornyei (2007: 105) states that questionnaires are highly versatile and they can be used by a variety of people in different environments, at different times, targeting a variety of topics for analysis.

According to Sekaran and Bougie (2010: 18), research is not just about gathering facts without purpose, or presenting information or data without interpretation. Rather, research is something that is undertaken to find out things in a systematic manner where data is collected and interpreted systematically and there is a clear purpose guiding the enquiry where it involves a series of well-planned and carefully executed activities to find solutions to research problems (Kreuger and Casey 2015: 33). Yin (2011: 13) examined qualitative research as part of a paradigmatic worldview that can illuminate specific contexts, while other methodologies have diverse purposes. Quantitative research relies on deductive reasoning or deduction (Sekaran and Bougie 2010: 31) and makes use of a variety of quantitative analysis techniques that range from providing simple descriptions of the variables involved to establishing statistical relationships amongst variables through complex statistical modeling. In comparison to quantitative research, qualitative research uses inductive reasoning (Sekaran and Bougie 2010: 31) and aims to acquire an in-depth understanding of human behavior and the reasons for the occurrence of that behaviour. On the other hand, Creswell (2012: 39) described the quantitative approach as a type of educational research in which the researcher decides what to study; asks specific, narrow questions; collects numeric (numbered) data from participants; analyses these numbers using statistics; and conducts the inquiry in an unbiased manner. Creswell (2012: 41) identifies its characteristics as the follows:

- ❖ An emphasis on collecting and analyzing information in the form of numbers;
- ❖ An emphasis on collecting scores that measure distinct attributes of individuals or organizations; and
- ❖ An emphasis on the procedures of comparing groups or relating factors about individuals or groups in experiments, correlational studies and surveys.

Questionnaires were used to gather quantitative data from teachers and learners to the extent to which Mathematics education provides valuable insights into teaching and learning. The researcher gained a better understanding of the status quo of teaching and learning of Mathematics at primary and secondary schools.

4.2.2 Qualitative research

According to Creswell (2012: 43) a qualitative study is defined as an inquiry process of understanding a social or human problem; based on building a complex, holistic picture; formed with words; reporting detailed views of informants; and conducted in a natural setting. Denzin and Lincoln (2011: 19) define qualitative research as multi-method in focus, involving an interpretive, naturalistic approach to its subject matter. Creswell (2012: 43) states that the qualitative approach in the form of a focus group interview provides rich detailed data from learners' and individual educators' personal experiences. Learners and educators will be interviewed separately. Interviews will be scheduled on another day, after the questionnaires are collected. The focus group interview is to draw upon learners' attitudes, feelings, beliefs, experiences and reactions to Mathematics as a subject. The data from the interview revealed deeper insights into learners' views of teaching and learning of Mathematics. These attitudes, feelings and beliefs may be partially independent of a group or its social setting, but are more likely to be revealed via the social gathering and the interaction within the focus group. Creswell (2012: 43) states that the qualitative approach in the form of an interview provides rich detailed data from teachers' personal experiences. These interviews will be conducted after the questionnaires are collected. Individual interviews with the educators aim to obtain individual attitudes, beliefs and feelings. The interviews with the educators consisted of Mathematics educators from primary and secondary schools. The one-to-one interview with the educator has been described as ‘a powerful method of data collection because it provides ‘one-to-one interaction’ between the interviewer and the interviewee (Punch 2005: 168) and describes it as ‘a very good way of accessing people’s perceptions, meanings and definitions of situations and constructions of reality.’ The individual interviews with the Mathematics teachers revealed the main interest is not what teachers are teaching, but how they are doing it and why? The researcher posed questions that were interested in establishing strategies and approaches to curriculum policies to Mathematics teaching, rather than their performance.

Cohen *et al.* (2011: 17) state that focus groups elicit a multiplicity of views and emotional processes within a group context as stated by and they are of the opinion that focus groups enable the researcher to gain a larger amount of information in a shorter period of time. Punch (2005: 11) posits that observational methods tend to depend on waiting for things to happen, whereas the researcher follows an interview guide in a focus group. The focus group interviews with the learners consisted of five learners from each of the secondary schools. Kreuger and Casey (2015: 34) state that it is from the interaction of the group that the data will emerge because the participants interact with each other rather than the interviewer, such that the views of the participants can emerge. As a result, the role of the interviewer changes from that an interviewer to that of a facilitator. The participants in this pilot study were excluded from the main study.

Qualitative research uses inductive reasoning and aims to acquire an in-depth understanding of human behaviour and the reasons for the occurrence of that behaviour (Sekaran and Bougie 2010: 32). This means that qualitative researchers study things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meanings people bring to them. Qualitative research involves the studied use and collection of a variety of empirical materials; case studies; personal experience; introspective; life story interviews; observational; historical; interactional and visual texts that describe routine and problematic moments and meaning in individual’s lives. Qualitative research can be referred to as interpretive research as its primary objective is not generalization but to provide deep interpretation of the phenomena and is used in many academic disciplines such as social sciences and market research (Denzin and Lincoln 2011: 20) particularly where the objective is to probe human behaviors and personalities. Cohen, Manion and Morrison (2011: 15) explain that:

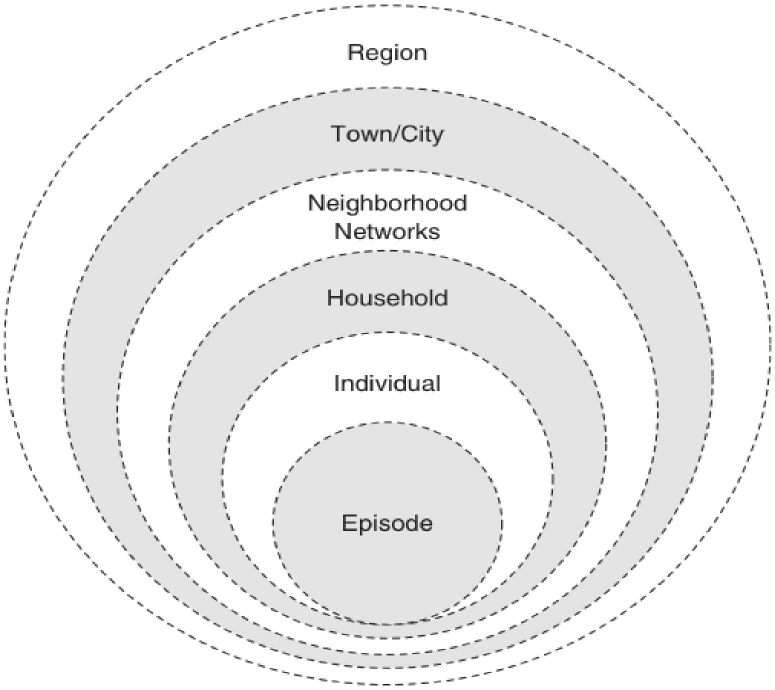
- There is a concern for processes rather than simply with outcomes;
- The natural setting is the principal source of data;
- Data are analyzed inductively using prior categories;
- Data are presented in terms of the respondents rather than researchers;
- Seeing and reporting the situation through the eyes of participants;
- Respondent validation is important; and
- Catching meaning and intention are essential.

Denzin and Lincoln (2011: 22) state that to help operationalize data collection procedures and tools is necessary to establish which dimensions of the human experience will comprise the core elements of the research problem. Each of these elements requires different approaches and procedures. They posit that it is important, therefore, to clarify in the early stages of designing the research which aspects researchers are most interested in examining. In many studies, it is often a combination of two or more of the following:

- Behaviors
- Attitudes/opinions/perceptions
- Knowledge
- Emotions and values
- Culturally shared meaning
- Social structures and relationships
- Processes and systems
- Environmental context

Bernard and Ryan (2010: 129) created a simple but useful diagram depicting levels of analysis, as illustrated by Figure 4.1. The authors state that, theoretically, a study can collect and compare data at various levels. In real life, levels of abstraction are not always as neatly defined as depicted in the graphic representation. There are many levels at which one can collect and organize data that are not represented.

Figure 4.1: Levels of analysis in qualitative study



Source: Bernard and Ryan (2010: 129)

The unit of analysis refers to the level at which data which is collected will be analyzed and they are often, but not always, the same thing (Bernard and Ryan 2010: 131). The example they refer to in focus groups interviews where the observational unit is both the individual and the interactions amongst individuals within the group. For participant observation, units of observation vary with the research context and can include individual or group behaviour, specific events or activities, or contextual factors such as physical environments. The diagram can be turned on its head and all of these factors which Bernard and Ryan (2010: 131) collectively call "context" influence individual behaviour, thoughts and experiences. The unit of analysis in a study is the level of abstraction at which you look for variability. The most commonly used unit in social-behavioral research is the individual. This is the level at which data is often synthesized and compared. Analysis of qualitative data can be carried out at higher levels of abstraction. In this research study, the unit can be an event, such as we might see in participants in the focus group interview designed to generate data about events.

Qualitative research is concerned with exploring social and human problems in a natural setting with the intention of understanding why people feel the way they do as well as the experiences that have caused them to have these feelings (Cohen *et al.* 2011; Maree 2010; and Sekaran and Bougie 2010). Interviews were used to gather qualitative data from the teachers and learners in this study Creswell (2012: 45) states that the qualitative approach provide rich detailed data from educators' personal experiences .

4.3 Pilot application of the research instruments

A pilot or feasibility study is a small experiment designed to test logistics and gather information prior to a larger study in order to improve the latter's quality and efficiency. The pilot study is a smaller-scale model of the researcher's study that was conducted before the actual research commences. The researcher randomly selected 10% of the sample of the learners and teachers to pilot test the questionnaires. The pilot study is conducted to improve the internal validity of the questionnaire by establishing whether the questions and technique are effective. The responses from the participants in the pilot study will be excluded from the main study because improvements were made from the pilot study design to avoid confusion. If no changes were made, then the researcher would have used the data from the pilot study. The researcher found there to be ambiguities and the respondents had difficulty in responding. The pilot application helped to avoid misleading, inappropriate, or redundant questions. Pilot study ensures that a research instrument can be used properly and that the information obtained is consistent.

A pilot study can reveal deficiencies in the design of a proposed experiment or procedure and these can then be addressed before time and resources are expended on large-scale studies. A good research strategy requires careful planning and a pilot study will often be a part of this strategy. A pilot study is normally small in comparison with the main experiment and can therefore provide only limited information on the sources and magnitude of variation of response measures. It is unlikely, for example, that a pilot study alone can provide adequate data. A systematic review of the literature or even a single publication is a more appropriate source of information on variability. The pilot study may, however, provide vital information on the proposed research. Cohen *et al.* (2011: 38) states that a pilot application increases the reliability, validity and practicability of the questionnaire.

Writing on the piloting of a questionnaire, Cohen *et al.* (2011: 41) list the following aspects to improve the quality of the questionnaire:

- Check the clarity of the questionnaire items;
- Instructions and layout;
- Gain feedback on the validity of the questionnaire items, the operationalization of the constructs and the purposes of the research;
- Eliminate ambiguities or difficulties in wording;
- Gain feedback on the type of question and its format;
- Check the time taken to complete the questionnaire;
- Check whether the questionnaire is too long or too short, too easy or too difficult, too unengaging or too threatening;
- Too intrusive or too offensive;
- Identify redundant questions;
- Identify commonly misunderstood or non-completed items; and
- Try out the coding/classification system for data analysis.

The questionnaires will be administered and collected by the researcher.

4.4 Focus group interviews

The main purpose of focus group research is to draw upon learners' attitudes, feelings, beliefs, experiences and reactions in a way that would not be feasible using other methods: for example observation, one-to-one interviewing, or questionnaire surveys. These attitudes, feelings and beliefs may be partially independent of a group or its social setting but are more likely to be revealed via the social gathering and the interaction which being in a focus group entails. Compared to individual interviews which aim to obtain individual attitudes, beliefs and feelings, focus groups elicit a multiplicity of views and emotional processes within a group context. The focus group interview allows participants to take the initiative. Compared to observation, a focus group enables the researcher to gain a larger amount of information in a shorter period of time. The recommended number of people per group is usually five to ten but some researchers have used up to fifteen people (Goss and Leinbach 1996: 117) or as few as four (Kitzinger 1995: 299). Observational methods tend to depend on waiting for things to happen, whereas the researcher follows an interview guide in a focus group. In this sense, focus groups are well-organized events. Focus groups are particularly useful when there are power differences between the participants and decision-makers or professionals, when the everyday use of language and culture of particular groups is of interest, and when one wants to explore the degree of consensus on a given topic (Kreuger and Casey 2015: 34). Kitzinger (1995: 300) argues that interaction is the crucial feature of focus groups because the interaction between participants highlights their views of the world, the language they use about an issue and their values and beliefs about a situation. Interaction also enables participants to ask questions of each other, as well as to re-evaluate and reconsider their own understandings of their specific experiences in Mathematics.

Another benefit is that focus groups elicit information in a way which allows researchers to find out why an issue is salient, as well as what is salient about it (Kitzinger 1995: 301). If participants reveal multiple understandings and meanings, multiple explanations of their behaviour and attitudes will be more readily articulated. During the focus group interview, the researcher needed to promote debate by asking open-ended questions. The learners also needed to be challenged, especially to draw out differences and bring out a diverse range of meanings on their experiences in Mathematics. Sometimes the researcher needed to probe for details or moved the discussion forward when the conversation was drifting or reached a minor conclusion. The researcher had to keep the session focused and sometimes had deliberately steered the conversation back on course. The researcher had to ensure that everyone participated and had got a chance to speak. Learners were asked to avoid giving personal opinions in order not to influence participants towards any particular position or opinion.

If a group works well, trust develops and the group may explore solutions to a particular problem as a unit (Kitzinger 1995: 301) rather than as individuals. Not everyone will experience these benefits, as focus groups can also be intimidating at times, especially for inarticulate or shy members. Hence, focus groups are not empowering for all participants and other methods may offer more opportunities for participants (Oppenheim 1992: 105). However, participants were actively involved during the focus group interviews and they felt that they would make a difference. Dornyei (2007: 111) emphasizes that focus group research is often of an applied nature and empowerment can realistically be achieved. Another advantage of focus groups to clients, users, participants or consumers is that they can become a forum for change (Goss and Leinbach 1996: 118) both during the focus group meeting itself and afterwards. For example, in research conducted by Goss and Leinbach (1996: 118), the participants in the research experienced a sense of emancipation through speaking in public and by developing reciprocal relationships with the researchers.

4.5 SERVQUAL application in the education sector

This study has used a modified SERVQUAL instrument to investigate expectations and perceptions of service quality within the education sector. During the last two decades, the customer-oriented education service concept has been developed in order to support demanding quality needs in education, more so in Mathematics. The 37th United Nations General Conference held in Paris in November 2013 confirms that member states, including SA, will prioritize education for all goals and committ themselves to new goals for education, based on access, equity, quality and lifelong learning. The key driver for change through its principal objective is to describe and measure the performance of education sectors and their contribution to teaching. Therefore, the "service quality" concept was used as one aspect. SERVQUAL examines five dimensions of service quality as illustrated by Table 4.1. Consequently, Parasuraman, Zeithaml and Berry (1994: 41) combined the SERVQUAL model with the local environment in which the research problem resides, thus identifying the service quality attributes in education settings. In analyzing service from the consumer's perspective, research by Parasuraman *et al.* (1994: 42) yielded a useful concept of ten potentially overlapping dimensions.

Table 4.1: Service Dimensions

1.**Tangibles**: Appearance of physical facilities, equipment, personnel and communications materials.
2. **Reliability**: Ability to perform the education dependably and accurately.
3. **Responsiveness**: Willingness to help learners and provide excellent service.
4. **Competence**: Possession of the required skills and knowledge to perform the service.
5. **Courtesy**: Politeness, respect, consideration and friendliness of contact personnel.
6. **Credibility**: Trustworthiness, believability and honesty of the service provider.
7. **Security**: Freedom from danger, risk or doubt.
8. **Access**: Approachability and ease of contact.
9. **Communication**: Keeping customers informed in language they can understand and listening to them.
10. **Understanding the learners:** Making the effort to know learners and their needs.

Source: Parasuraman *et al.* 1994: 42

However, this contextualization with the local environment was very much limited towards only the domains defined in the SERVQUAL model. However, the researcher used the data collected from surveys and focus groups to modify the SERVQUAL model in order to develop a robust survey instrument for the measurement of service quality. As a way of measuring service quality, researchers developed a methodology known as SERVQUAL, a perceived service quality questionnaire survey methodology. The authors defined service quality as the gap between consumer expectations and perceptions. This gap arises when the consumer misinterprets the service quality. For example, a teacher may continue teaching Mathematics to the learners and ensure care, but the learners' have a negative interpretation of Mathematics. This is an indication that something is really wrong. These original dimensions served as the initial structure of a service quality measurement instrument (SERVQUAL) that was later created by these academics.

The questionnaires for the primary and secondary Mathematics teachers were adapted from the SERVQUAL questionnaire to determine perception of service quality, namely: reliability; assurance; tangibles; responsiveness; and empathy (Parasuraman *et al.* 1994: 42). The open-ended questions, which relate to experiences with learners in teaching Mathematics have an advantage in that the researcher obtained information that was not initially anticipated. Therefore the open-ended questions were useful because teachers could express their views in an unbiased manner.

However, this researcher used the data collected from surveys and focus groups to modify the SERVQUAL model in order to develop a robust survey instrument for service quality within the Mathematics domain. Concluding with the applicability of the SERVQUAL model in the education sector, an assortment of results connected to different domain structures and attributes were produced. It is therefore clear that SERVQUAL is a suitable model for measuring the customer satisfaction construct and/or service quality construct in the discipline of Mathematics education. Moreover, current research trends in relation to customer satisfaction in the area of service marketing suggest that SERVQUAL's primary concern is with gauging service quality in a given scenario. In this context, it is pertinent to point out that though SERVQUAL is a generic model common to all kinds, and it requires customization for use within educational settings.

A study by Parasuraman *et al.* (1988: 14) highlights several advantages over earlier assessment instruments. They find that:

- ❖ SERVQUAL is designed to elicit responses from a sample of both learners and teachers;
- ❖ It accounts for respondents' minimum and desired levels of performance, rather than relying solely on their perceptions of current conditions;
- ❖ It provides multiple benchmarks for the comparison of institutions;
- ❖ It meets established criteria for reliability and uses questions derived from in-depth interviews with learners and teachers; and
- ❖ It identifies the various facets of perceived quality.

The attributes nevertheless covered by SERVQUAL are appropriate for Mathematics education. SERVQUAL is flexible and can be modified to suit special sectors in education. SERVQUAL is recognized as a tried and tested instrument that has been successfully applied in various contexts (O'Neill and Palmer 2004: 39). Its strengths more than outweigh deficiencies and the results can be presented in a format useful for targeting specific service improvements (O'Neill *et al.* 2004: 40). However, according to researchers, Hernon and Nitecki (2001: 687) who have shown a clear preference, for SERVQUAL which has the facility for broad application to service industries. Parasuraman *et al.* (1994: 115) point out that some respondents may not possess the necessary knowledge to respond to some of the SERVQUAL items and therefore a mid-point rating of the perceptions scale must be recorded. According to White and Abels (1995: 38), SERVQUAL has become the most widely used instrument for measuring service quality in profit and non-profit organizations and no other instrument has been tested as stringently and comprehensively as SERVQUAL.

4.6 Identification of service quality attributes in Mathematics

Following a thorough examination of studies in the areas of quality in the education sector, it appears appropriate to examine the attributes that affect service quality in Mathematics. The quality attributes, domains and pertinent settings used in past studies of service quality and/or customer satisfaction are presented in the next paragraph. As illustrated, it is apparent that of the forty-two countries that participated in TIMSS 2011 at the Grade 9 level, five Asian countries, namely: Korea, Singapore, Chinese Taipei, Hong Kong and Japan have the highest achievement scores and SA continued to demonstrate the lowest performances at this level for both Mathematics and Science. Whilst Asian, European countries and the USA have dominated the results in the TIMSS study. As discussed in Chapter 1, learners are performing poorly in the ANA national test and NSC examination. A conclusion that may be drawn from the above is that service quality attributes are becoming important aspects in emerging research in the said subject area because most of the attributes are found to be common to all contextual environments. These studies emphasize similarities, while most of the quality domains of the reported studies remain remarkably different in varying cultural settings. It is evident that Mathematics in SA is in dire need of service quality.

4.7 Writing of a SERVQUAL report

Latour (2007: 9) suggests that researchers keep track of all their moves, even those that involved the writing of this report because "everything is data, even those that deal with the production of the report". The records were maintained electronically and manually in this study. A manual journal was collated and all correspondence sent to the schools during the data collection were filed. The schematic representation in Table 4.2 illustrates what the file looked like.

Table: 4.2 Table for data constitution

Node	Practice followed	Target	Instruments used to collect data
1. DoE	Cascading of policy documents	Policy Documents. ANA and NSC results. Statistics of learners at schools	Responses from questionnaire on mediation of policy
2. Primary School	Implementation of policy. Mediation of teaching and learning	Mathematics teachers and learners	Questionnaire, interview
3. Secondary School	Implementation of policy. Mediation of teaching and learning	Mathematics teachers and learners	Questionnaire, interview

Source: Self-generated by researcher

The schematic representation in Table 4.3 illustrates what the presentation of data revealed and some the associations that exist at the various nodal levels.

Table 4.3: Table for data analysis

DoE, primary school and secondary school nodes	Interface from one node to the other
Data collected at each node were interrogated.	Networks were placed side by side.
The data were read and analysed several times to identify key elements.	The networks were examined for points of convergence in respect of policy construction and SKAV constitution to ascertain if there was an interface.

Patterns of meanings were established.	Since an interface existed, the researcher noted all factors that altered the optical density of each node from the nodal networks.
Patterns of meanings that were similar were grouped together.	The responses at each node were inspected to explore how they traversed and infiltrated the other nodes, ie. from DoE to primary schools and secondary schools.
The impact of the associations were noted.	The networks were examined for points of convergences in respect of teaching and learning to ascertain if there was an interface.
Associations formed at primary and secondary schools were noted for convergences or divergences.	The researcher noted how the networks were responsible for the refraction at the point of interface in order to describe the nature of the interface.

Source: Self-generated by researcher

Writing a SERVQUAL report is not for epistemic reasons but also because everything is considered to be data (Latour 2007: 10). (Latour 2007: 11) further suggests that four records be maintained for the following purposes:

- ❖ to serve as a log of the enquiry in terms of due dates, time frames and appointments;
- ❖ to record data findings;
- ❖ to record data analysis while still doing field work; and
- ❖ to map the social from the network traced.

The dates file served as an electronic diary for appointments with the supervisor, dates of Faculty and Higher Degree submissions; due dates in respect of ethical clearance and data collection at the DoE and schools node; and dates for time frames of the study. Data analyses at various nodal levels were interrogated.

4.8 Target Population

According to Bambale (2014: 871), the population of a study refers to the entire group of people, events or things of interest that the researcher wishes to investigate. The author further stated that population of the study is the group of people, events or things of interest for which a researcher wants to make inferences based on a derived sample. This study was conducted in the Mafukezela-Gandhi Circuit in KwaZulu-Natal. The Mafukezela-Gandhi Circuit consists of 130 primary schools. Each primary school has an average of 73 Grade 7 learners per school. The total population of the Grade 7 primary school learners is 9 521. A total of 369 questionnaires were given to Grade 7 learners at 8 primary schools. The Mathematics educators at the primary schools filled the questionnaires and those who were willing were interviewed because it was optional.

There are 72 secondary schools in the Mafukezela-Gandhi Circuit in KwaZulu-Natal. Each secondary school has grades 8, 9, 10, 11 and 12 classes. Each school consisted of an average of 694 learners. The total population for the secondary school learners is 49 998. A total of 450 questionnaires were given to learners at 12 secondary schools. Those learners who indicated that they would participate in the focus group interview formed the participants. The Mathematics educators at the secondary schools filled the questionnaires and those who indicated that they would participate in the interview formed the participants and they were interviewed.

4.9 Purposive sampling

In order to answer the questions raised by this study, purposive sampling has been used because the study does not aim to generalize the findings (Cohen *et al.* 2011: 23). The sample was selected purposively, utilizing a convenience-sampling scheme (Miles and Huberman 2014: 15). Defining this method of sampling, Punch (2005: 187) explains that 'it means sampling in a deliberate way, with some purposes or focus in mind' and Creswell (2012: 52) states that the logic and power of purposive sampling lies in selecting information-rich cases for in-depth study. The researcher selected learners from grade 7 at primary schools and learners from grades 9 to 12. Grade 8 learners were omitted because data was captured early in Term 2 of the school year and many of these learners were new at secondary school and they had to contend with adjustments and changes from primary school. A change from primary to secondary school can be overwhelming for some learners and this could have an impact on them. I selected learners from grades 9 to 12 to gauge if the drop in results at grade 9 level continued to Grade 12 or did it change. The researcher found it imperative to analyse the Grade 7 and Grade 9 ANA results. ANA is a national paper in Mathematics. The Grade 8 learners do not write ANA and there are no national results in Mathematics for the Grade 8 learners. The researcher found it necessary to select the FET phase because one can see the impact in the Grade 12 results when it goes out into the public domain. Usually the Grades 7 to 9 is overlooked. The teachers who teach Mathematics in the selected grades were the respondents.

By asking pertinent questions, Miles and Huberman (2014: 216) give a checklist on sampling in research. These are:

- ❖ Is the sampling relevant to the conceptual frame and research questions?
- ❖ Will the phenomenon the researcher is interested in appear?
- ❖ Does the plan enhance generalizability of the findings, through either conceptual power or representativeness?
- ❖ Can believable descriptions and explanations be produced - ones that are true to real life?
- ❖ Is the sampling plan feasible in terms of time, money, access to people and the researcher's own work style?
- ❖ Is the sampling plan ethical in terms of such issues as informed consent; potential benefits and risks; and the relationship with informants?

Guba and Lincoln (2005: 205) state that a researcher working within a paradigm must demonstrate a congruence between the ontological question (what is the form and nature of reality?), the epistemological question (what is the nature of the relationship between the knower and what can be known?) and the methodological question (how can the researcher find out about the nature of reality? The researcher has taken cognizance of all the above attributes when formulating the questions in the questionnaire and interview. Guba and Lincoln (2005: 201) argue that the answers to the ontological question, the epistemological question and the methodological question are interconnected in such a way that the answer given to any one question, taken in any order, constrains how the others may be answered.

Bambale (2014: 872) states that a sample is a set of individuals or participants selected from a larger population for the purpose of a survey. An optimal sample is important for minimizing the cost of sampling error, thus indicating the need for selecting an appropriate sample size. Kreuger and Casey (2015: 35) specifically emphasized that an appropriate sample size is necessary for any research because too small a sample size is not a good representative of the population. The researcher included participants in the sample on the basis of the specific needs of the research and learners were selected from various schools because they have the characteristics that the study requires. The purpose of this type of sampling is to get information or data from those who are in a position to give it.

Table: 4.4   Sample size and population

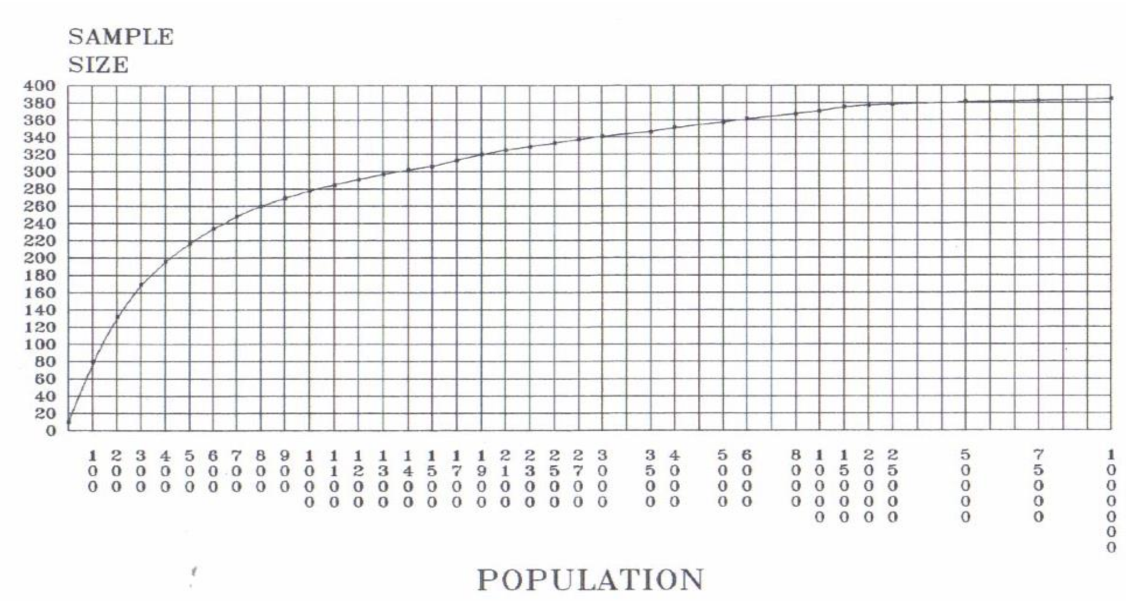
N	S	N	S	N	S
10	10	1 000	278	20 000	377
20	19	8 000	367	40 000	380
100	80	9 000	368	50 000	381
210	136	10 000	370	500 000	382
500	217	15 000	375	1 000 000	384

Note: *N* is population size. *S* is sample size.

Resource: Krejice and Morgan (1970: 608)

Sample size is determined from the population as indicated in Table 4.4 taken from Krejice and Morgan (1970: 608), which is also graphically represented in Figure 4.2. The relationship between sample size and total population is illustrated in the table (Krejice and Morgan 1970: 608). (Krejice and Morgan 1970: 609) add that as the population increases, the sample size increases at a diminishing rate and remains relatively constant at slightly more than 380 cases for a population of 1 000 000. Based on Figure 4.2, the sample for this study was determined as follows: from a total of 59 519 learners, 381 made up the sample. A total of 450 questionnaires for learners were distributed to 12 of the secondary schools and 370 were sent to 8 primary schools. Twenty-eight Mathematics teachers from the 12 secondary and 8 primary schools indicated that they were willing to participate in the interviews that made up the teacher sample. To select the learner sample, the researcher obtained the class lists of names of learners from the selected schools. The researcher then used the Microsoft Excel Sampling: Data Analysis option to randomly select the required number of participants. Qualitative and quantitative data were gathered from the learner and teacher samples.

Figure 4.2: Graphical representation of sample size versus population



Resource: Krejice and Morgan (1970: 609)

4.10 Reliability, validity, trustworthiness and triangulation

The trustworthiness of the study is established through the non-judgmental behaviour of the researcher and the researcher should be open to all responses during the interview process. Furthermore, the questions in the questionnaire were expressed in a simple manner. The researcher remained objective at all times. Anonymity of all participants was guaranteed, as they would only be identified by codes. Recorded interviews were confidential. The data collected through the interviews and questionnaires were stored and would only be available to the researcher and the supervisors until such time that it will be discarded in a manner that ensures participants' confidentiality is upheld.

Validity and reliability measure the trustworthiness of the research. Bambale (2014: 874) states that internal measures measure what it is supposed to measure and external measures hold across different settings, procedures and participants. Bambale (2014: 874) also argues that reliability is the consistency of a set of measurements or measuring instrument and internal consistency can be estimated with Cronbach's Alpha (α). Maintaining high credibility and objectivity increased the trustworthiness of the qualitative study. In order to maintain high trustworthiness in a qualitative study, Dornyei (2007: 106) suggested four criteria to ensure the valid interpretation of data, namely: truth-value, applicability, consistency and neutrality. In the qualitative approach, truth-value is measured by credibility: having an adequate engagement in the research setting so that recurrent patterns in data can be properly identified and verified.

According to Creswell (2012: 51), triangulation is one of the means of validating the accuracy of findings in research and it involves the use of different data sources of information by examining evidence from the sources. For the purpose of triangulation, the data collection concluded with interviews. Beginning with the teachers, the researcher wanted to ascertain issues pertaining to teachers' knowledge and skills; their dispositions to content, to the learners and towards innovation in general; and their sense of self as teachers and as lifelong learners of Mathematics. For the learners, the researcher probed their dispositions and engagement with the subject matter and the teaching and learning processes. Document analysis and interviews were used for this purpose.

In document analysis, Cohen *et al.* (2011:51) postulates that the data collected by written documents will be analyzed to make sense about the situation, noting patterns and categories. The significant need for document analysis compared to other research techniques is the analysis of written documents which avoids researcher influence on the data as with questionnaires, observations and interviews. A comparison of educational policies and teachers' views towards Mathematics will be carried out through document analysis. While referring to documentary data, which could be qualitative or quantitative in nature, Punch (2009: 38) explains that these can be used in conjunction with other instruments of research. Denzin *et al.*

(2011:57) argue that all behavior is based on interpretation. Therefore the perceptions and experiences of all the participants will be analyzed appropriately. The current study will unravel things in a systematic manner when data is collected and interpreted (Creswell 2012: 45). Integrating quantitative and qualitative research methods lends depth and clarity to this research study. Ideally if both the quantitative and qualitative research approaches are used concurrently, the findings yielded are more reliable. This was applied in this study. Denzin (1970: 297) asserts that triangulation is the combination of methodologies in the study of the same phenomena. He argues that by using different methodological approaches to study the same phenomena, it should lead to greater validity and reliability than a single methodological approach. In this study, the researcher endeavored to use data accurately, representatively without making vague and unsubstantiated generalizations. Invalidity has been avoided as poor research procedures can undermine validity and can degrade the precision of a single measurement, and this can also reduce the ability to characterize relationships between variables in descriptive studies (Cohen *et al.* 2011:55). Hence, the critical aspects of reliability, validity, trustworthiness and triangulation have ensured that the findings in this study are credible. The researcher achieved these aspects in the study when all sources of data arrived at the same conclusion.

4.11 Ethical issues

Ethical clearance for the study and all the data collection instruments was obtained from the Institutional Research Ethics Committee at the Durban University of Technology. Permission was obtained from The DoE and school principals to conduct research at the various schools. The researcher applied for ethical clearance from the Durban University of Technology and obtained permission from the principals for the use of the schools as a research facility within which the research could be conducted in accordance with the ethical guidelines that were presented to them. The researcher also obtained permission from Mathematics educators to conduct research during their Mathematics classes. Due consideration had to be noted regarding ethical issues that could arise when using learners as part of the data collection process. The challenges that these ethical issues present are diverse since the participants are minors. The researcher had to acknowledge that the information that was sought may vary and some learners were not willing to share such information. The power differential between the learner and researcher might make the learners feel obligated to participate in the study even though they might not want to participate in this research (Cohen *et al.* 2011: 39). The researcher assured the learners that there will be no compulsion for them to participate in the study and that they should not fear reprisal from anyone if they chose not to participate or if they withdrew from the study at any time.

It was necessary for permission to be obtained from learners' parents or guardians. Letters of consent were sent to parents of the Grade 7 learners in the primary schools and learners from Grades 9, 10, 11 and 12 in the secondary schools. The letters were in English and another explaining in IsiZulu for those parents who could not understand English. The learners were given the letters of informed consent to take to their parents for signatures. Those who were willing to participate in the group interviews formed the participants in the focus group interview. A letter of information was given to the educators and learners to inform them of the details and the nature of the study so that they were in a position to grant written informed consent to participate in this study. The consent letter explained the area of research, together with its broad aims and purposes. Participants also signed letters of informed consent. The researcher ensured their anonymity by keeping data and details confidential.

Ethical considerations for focus groups are the same as for most other methods of social research (Cohen *et al.* 2011: 41). For example, when selecting and involving participants, researchers must ensure that full information about the purpose and uses of participants' contributions is given. Being honest and keeping participants informed about the expectations of the group and topic, and not pressurizing participants to speak was a good practice. A particular ethical issue to consider in the case of focus groups is the handling of data and confidentiality given that there will always be more than one participant in the group. At the outset, the researcher had to clarify that each participant's contribution would be shared with the others in the group, as well as with the supervisor. Participants were encouraged to maintain confidentiality of what was articulated. Due to the participants' interaction with each other, confidentiality was vital. The role of the interviewer changes from that of an interviewer to that of a facilitator.

4.12 Data collection

In the quantitative methodology, the learners and educators complete separate questionnaires. The instrument the researcher used was adapted from the Quality of Instructor Service to Students (QISS) questionnaire (Emanuel and Adams 2004: 536) modified from the SERVQUAL instrument, which was developed by Parasuraman *et al.* (1994: 15). The questionnaires also included questions on teacher and learner efficacy. Learners' expectancies for success in Mathematics; perceptions of their performance in Mathematics; and perceptions of the difficulty of Mathematics were included in the learner efficacy questionnaire, which was originally developed by Parsons (1980: 5). The teacher questionnaire was based on Bandura's instrument of teacher self-efficacy (1986: 13), assessing a wide range of beliefs, including teachers' trust and respect for learners and feelings of personal teaching efficacy. The teachers' questionnaires also included closed and open-ended questions. Sekaran and Bougie (2010: 39) state that the questionnaire involves a series of well-planned and carefully executed activities to find solutions to research problems. The choice of questionnaire format was decided upon because the closed questions were designed to elicit fixed responses from respondents, while the open-ended questions were designed to give respondents freedom to express themselves.

In the qualitative methodology, the learners and educators participated in interviews. This researcher raised issues for discussion regarding Mathematics and the participants were encouraged to discuss the issues with the researcher in an informal and relaxed environment.

4.13 Administration of the questionnaires

The researcher administered the questionnaires to the learners and teachers. The researcher informed learners and teachers to drop their completed consent forms into a box that was housed in the Mathematics Head of Department's office at their schools. The educators were given one week to complete the questionnaire. The names of the participants and the name of the schools did not appear on the questionnaires. Each questionnaire was numbered to maintain anonymity and to keep the data they provided confidential.

4.14 Layout of the questionnaires

The teacher questionnaires contained four sections. Section A had four questions about the teacher; Section B had eighteen questions about the teachers' professional development which is adapted from the SERVQUAL questionnaire to determine perception of perceived service quality, namely: reliability; assurance; tangibles; responsiveness; and empathy (Parasuraman *et al.* 1994: 117). Section C included open-ended questions which related to experiences with learners in teaching Mathematics. Section D was based on Bandura's (1997: 23) self-efficacy questionnaire that consisted of five statements. The questions in the questionnaires had simple language and clear instructions and were related to Mathematics. The questionnaires were in English because learners were from English medium schools.

The primary school learner's questionnaire contained four sections. Section A had four questions about the learner; Section B had six questions about learner self- and Task- Related Beliefs in Mathematics; Section C had fifteen statements about learner self-efficacy in Mathematics and Section D was about their Mathematics teacher and it consisted of six questions which is adapted from the SERVQUAL questionnaire regarding learners' perceptions, expectations and experience of Maths *viz*: reliability; assurance; responsiveness and empathy (Parasuraman *et al.* 1988: 24).

The secondary school learner's questionnaire contained five sections. Section A had six questions about the learner; Section B had nine statements related to their primary and secondary school Mathematics; Section C had fifteen statements about learner self-efficacy in Mathematics and an open ended question about perception and expectations about Mathematics in terms of support and subject matter; and Section D was about the Mathematics teacher and it consisted of six questions which were adapted from the SERVQUAL questionnaire regarding learners' perceptions, expectations and experiences of Mathematics, namely: reliability; assurance; responsiveness and empathy (Parasuraman *et al.* 1994: 119). Learners from the secondary schools were given an option to decide whether they wanted to engage in a focus group interview or not. Those who were keen in participating were interviewed.

4.15 Data analysis

The questionnaires elicited quantitative and qualitative responses. Data from the questionnaires was analyzed by using the latest version of SPSS (Statistical Package for the Social Sciences). The SPSS programme allowed for a complete analysis of data in the following categories: descriptive statistics; describing the main features of a collection of data through cross tabulation; frequencies; and descriptive ratio statistics. The recorded focus group interviews with the learners and individual interviews with the teachers were analyzed. The setting in which the practice occurred and the learning that took place was crucial for the constitution of SKAV development, other networks of practice and how these impacted on the practice that existed. This provided an empirical basis for discussing the current practice. Analysis pertaining to each node and key terms were identified and patterns of meanings were also established.

The theoretical frameworks guided the researcher's reading and allowed the researcher to focus on what was mentioned and done in practice in order to defragment and inspect what was said and done in order to allow learners and teachers to develop and construct their reality of what constitutes their practice (Latour 2005: 21). In this regard, Law (2010: 2) maintains "in teaching telling is doing". According to Law (2010: 3), words are performative, they do not just describe, and in describing they also denote action. This means that the description helps to illustrate what words are describing teaching and learning in Mathematics in primary and secondary schools. The data collected from the teachers' interviews were used to constitute data in respect of policy construction. The researcher paid attention to what the Mathematics teachers said or did about schooling and the policy and the impact of these on the construction of policy.

Documents collected for this study are both qualitative (policy documents, DoE bulletins and outcomes of quality assurance reviews) and quantitative in nature (records of performance of learners in Mathematics in ANA and NSC examination).

The researcher then looks for causal conditions, strategies, the context and intervening conditions, and the consequences. The results from ANA and NSC in Mathematics were obtained from the DoE and TIMSS results were obtained from current journals. These results were interrogated according to learner attainment and this was a good performance indicator of the levels at which learners were understanding Mathematics.

4.16 Conclusion

Chapter four focused on the research methodology that was employed in this study and outlined reasons as to why a specific methodology was chosen. The Chapter thereafter describes the research paradigm that was used. Justification for using the quantitative and qualitative methods was provided. Sufficient details on the sampling process were elaborated. In discussing data collection, the importance of validity, reliability and ethical considerations in the research were discussed. The research instruments used for this study were highlighted. This chapter also focused on how quantitative and qualitative data were analyzed. The next chapter focuses on the presentation and analysis of the data that was obtained.

CHAPTER 5

STATEMENT OF FINDINGS, INTERPRETATION AND DISCUSSION OF THE PRIMARY DATA

5.1 Introduction

This chapter presents the results and the findings obtained from the questionnaires and interviews in this study. The questionnaire was the primary tool that was used to collect data and was distributed to learners between Grades 9 to 12 at secondary schools and Grade 7 learners at primary schools in the Mafukuzela-Gandhi Circuit in KwaZulu-Natal. The data collected from the responses was analyzed with SPSS version 22.0. The results present the descriptive and statistical data in the form of graphs, cross tabulations and other figures for the quantitative data that was collected. Inferential techniques include the use of correlations and chi square test values, which are interpreted using the p-values.

5.2 The sample from the secondary school learners

In total, 450 questionnaires were dispatched to 12 secondary schools and 329 were returned ,which gave a 73% response rate.

5.3 The research instrument

The research instrument consisted of 49 items, with a level of measurement at a nominal or an ordinal level. The questionnaire was divided into 4 sections, which measured various themes as illustrated below:

Section A - Biographical Information

Section B - About your primary school Mathematics

Section C - Learner Self-efficacy in Mathematics

Section D - My Mathematics Teacher

5.4 Reliability statistics

The two most important aspects of precision are reliability and validity. Reliability is computed by taking several measurements on the same subjects. According to

Darling-Hammond (1983: 23), a reliability coefficient of 0.70 or higher is considered as “acceptable”. Reliability is computed by taking several measurements on the same subjects into account, to ascertain whether the findings of the study are indeed credible and reliable.

Table 5.1 reflects the Cronbach’s alpha score for all the items that constituted the questionnaire.

Table 5.1: Cronbach’s alpha score

Section	Number of Items	Cronbach's Alpha
C – positive statements	4 of 5	0.687
C – negative statements	8 of 10	0.733
D - My Mathematics Teacher	12 of 12	0.758

The reliability scores approximate or exceed the recommended Cronbach’s alpha value of 0.700. This indicates a degree of acceptable, consistent scoring for the sections comprising the research.

5.5 Factor analysis

Why is factor analysis important?

Factor analysis is a statistical technique whose main goal is data reduction. According to Gorsuch (1983: 23) the origins of factor analysis can be traced back to Pearson (1901) and Spearman (1904). The main aim of factor analysis is to simplify a set of complex data by representing the variables in terms of a smaller number of underlying (hypothetical or unobservable) variables, known as factors. A typical use of factor analysis is in survey research, where a researcher wishes to represent a number of questions with a small number of hypothetical factors. For example, as part of a national survey on political opinions, participants may answer three separate questions regarding environmental policy reflecting issues at the local, state and national level. Each question, by itself, would be an inadequate measure of attitude towards environmental policy, but *together* they may provide a better measure of the attitude. Factor analysis can be used to establish whether the three measures do, in fact, measure the same thing. If so, they can then be combined to create a new variable, a factor score variable, that contains a score for each respondent on the factor. Factor techniques are applicable to a variety of situations. For example, a researcher may want to know if the skills required to be a decathlete are as varied as the ten events, or if a small number of core skills are needed to be successful in a decathlon. One need not believe that factors actually exist in order to perform a factor analysis but in practice, the factors are usually interpreted, given names and spoken of as real things. The matrix table is preceded by a summarized table that reflects the results of the KMO and Bartlett's Test. The requirement is that the Kaiser-Meyer-Olkin Measure of Sampling Adequacy should be greater than 0.50 and Bartlett's Test of Sphericity less than 0.05. In all instances, the conditions are satisfied which allow for the factor analysis procedure. Factor analysis is done only for the Likert scale items. Certain components are divided into finer components. This is explained below in the rotated component matrix.

Table 5.2: KMO and Bartlett's Test

	Kaiser-Meyer-Olkin Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
		Approx. Chi-Square	df	Sig.
C – positive statements	.694	252.249	10	.000
C – negative statements	.843	899.548	36	.000

All of the conditions are satisfied for factor analysis.

Table 5.3: Rotated Component Matrix

C – positive statements	Component	
	1	2
I am good at Maths	.859	-.021
I am confident of myself when I do Maths	.812	.124
My teacher makes me feel that Maths is useful in everyday life	-.064	.904
Overall I find the Maths lessons at school interesting	.474	.594
My teacher thinks that I can do well in Maths	.513	.392

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Table 5.4: Negative Statements

C – negative statements	Component	
	1	2
I do not enjoy Maths	.600	-.372
Primary school Maths was not challenging	-.262	.684
Maths that I learnt in primary school does not help in secondary school	-.130	.857
Maths that I learn in secondary school is different from the Maths I learnt at primary school	-.026	.831
I find Maths too difficult for me	.802	.042
Maths is dull and boring	.547	-.398
Learning Maths is too stressful	.714	-.133
I would avoid studying Maths after matric	.652	-.390
Maths is my worst subject	.809	-.072

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Factor analysis is a statistical technique whose main goal is data reduction. A typical use of factor analysis is in survey research where a researcher wishes to represent a number of questions with a small number of hypothetical factors. With reference to the table above:

- The principle component analysis was used as the extraction method and the rotation method was Varimax with Kaiser Normalization. This is an orthogonal rotation method that minimizes the number of variables that have high loadings on each factor. It simplifies the interpretation of the factors.
- Factor analysis/loading shows inter-correlations between variables.
- Items of questions that loaded similarly imply measurement along a similar factor. An examination of the content of items loading at or above 0.5 (and using the higher or highest loading in instances where items cross-loaded at greater than this value) effectively measured along the various components.

It is noted that the variables that constituted the positive and negative statements loaded along 2 components (sub-themes). This means that respondents identified different trends within the sections. Within the sections, the splits are colour coded.

Learners indicate positive trends in scores marked in yellow and negative trends are indicated in green. Some of the positives were the following: “I am good at Maths” and “I am confident of myself when I do Maths.” A few of the negative trends were as follows: “Primary school Maths was not challenging”, “Maths that I learnt in primary school does not help in the secondary school” and “Maths that I learn in secondary school is different from the Maths I learnt at primary school.” These statements provide possible answers to the critical question about learners’ perceptions, expectations and experiences of Mathematics at primary school level in preparing them for secondary school Mathematics. It is also beginning to surface that there is an interface between primary and secondary phase Mathematics as pointed out by Rammala (2009: 90) that the transition period is characterized by negative attitudes towards Mathematics and learners’ performance decreases when they go to secondary school.

5.6. Section A: Learners particulars

This section reveals relevant information about the learners’ personal particulars.

5.6.1 Biographical data

This section summarizes the biographical characteristics of the respondents.

Table 5.5: Gender distribution

		Females	Males	Total
14	Count	24	22	46
	% within What is your age?	52.2%	47.8%	100.0%
	% within What is your gender?	13.6%	14.4%	14.0%
	% of Total	7.3%	6.7%	14.0%
15	Count	73	61	134
	% within What is your age?	54.5%	45.5%	100.0%
	% within What is your gender?	41.5%	39.9%	40.7%
	% of Total	22.2%	18.5%	40.7%
16	Count	38	36	74
	% within What is your age?	51.4%	48.6%	100.0%
	% within What is your gender?	21.6%	23.5%	22.5%
	% of Total	11.6%	10.9%	22.5%

17	Count	25	18	43
	% within What is your age?	58.1%	41.9%	100.0%
	% within What is your gender?	14.2%	11.8%	13.1%
	% of Total	7.6%	5.5%	13.1%
18	Count	15	14	29
	% within What is your age?	51.7%	48.3%	100.0%
	% within What is your gender?	8.5%	9.2%	8.8%
	% of Total	4.6%	4.3%	8.8%
19	Count	1	2	3
	% within What is your age?	33.3%	66.7%	100.0%
	% within What is your gender?	0.6%	1.3%	0.9%
	% of Total	0.3%	0.6%	0.9%
Count		176	153	329

Cross-tabulation is a way of understanding the relationships that exist between two or more variables (Bertram 2004: 194). In this case the relationship between gender and age is cross-tabulated with the various age groups as tabulated in the table above. Table 5.5 describes the overall gender distribution by age. Within the age category of 14-year olds, 47.8% were males and 52.2% are females. Males constituted 46.6% and females constituted 53.5% of the total sample. There was a majority of females in all age categories.

Figure 5.1: Grades of learners

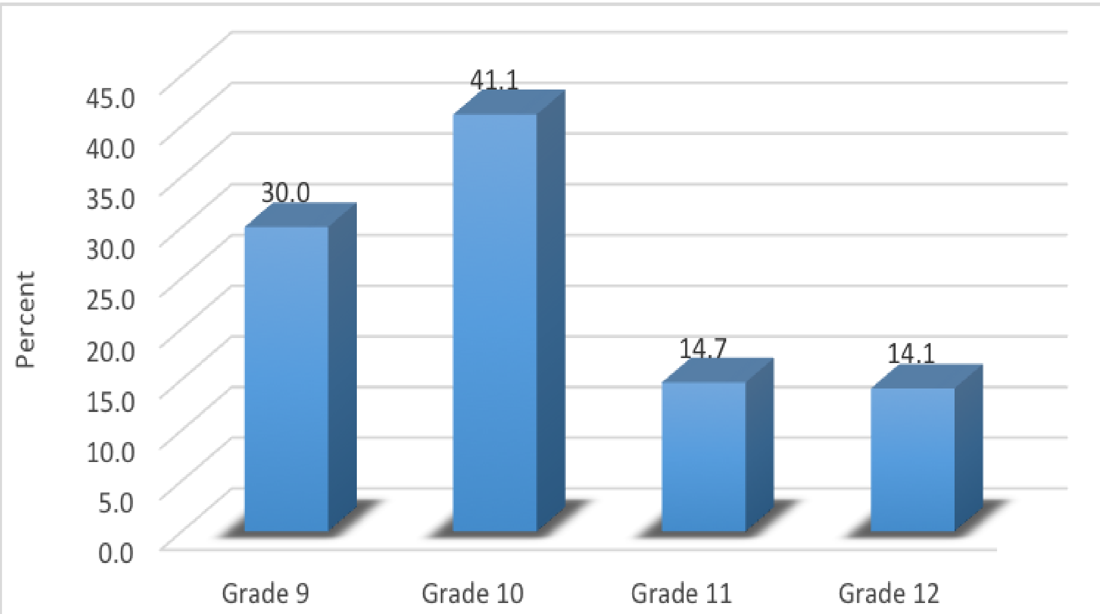


Figure 5.1 indicates the grades of the learners. Approximately a third of the learners (30.0%) were in the junior secondary phase. Of the senior secondary learners, most were in Grade 10 (41.1%). Many schools could not complete the questionnaire timeously due to workloads and assessments done in Grades 11 and 12. Therefore, Grades 9 and 10 had the highest number of completed questionnaires returned. Overall, nearly two-thirds (62.16%) of the respondents spoke English at home, with the remainder being IsiZulu speakers.

Table 5.6: Home language of the learners

	Percentages of learners				Total
	Grade 9	Grade 10	Grade 11	Grade 12	
English	28.00	88.32	51.02	70.21	62.16
IsiZulu	70.00	10.22	48.98	27.66	36.34
Xhosa	2.00	1.46	0.00	2.13	1.50
Total	100.00	100.00	100.00	100.00	100.00

It is observed that the grade 9 learners in secondary school have predominantly more IsiZulu speakers (70.00%) than language of learning and teaching. From Grade 10 to Grade 12 learners, English is the dominant home language. The location of the schools also impacted on the racial denomination of the learners. A comparison of the respondents who completed the questionnaire reveals that this percentage is in keeping with the demographic profile of learners in the KwaZulu-Natal Department of Education. Language could be a possible reason why learners experience difficulties in understanding Mathematics content as the language used in Mathematics is probably too Anglo-Saxon and English is not the home language for the majority of learners. This points to the linguistic demands placed on learners as they face problems in the language-in-education policy and the politics and practices associated with English as the dominant language of instruction. This concurs with Bantwini’s (2010: 87) findings of learning and teaching and the contradictory role of English as a language of access to socio-economic progress on the one hand, yet not an equitably available and developed resource for learning Mathematics for most South African learners.

Figure 5.2 illustrates the level of enjoyment of learners in Mathematics at primary and secondary schools. On average, 88.1% of learners indicated that they enjoyed Mathematics at primary school. The current grade of learners who least liked Mathematics at school are the grade 11 learners (27.08%). The percentage drops from 99% to 47.42% for Grade 9 learners who enjoy Mathematics at secondary school, with similar numbers of learners enjoying Mathematics at high school and those who are not. Learners from Grades 9, 10 and 12 revealed that their enjoyment in Mathematics had deteriorated when they went into secondary school as illustrated in Figure 5.2 except for Grade 11 learners where 56.25% of them enjoyed Mathematics at secondary school. The excerpts below highlight comments made by a few Grade 11 learners:

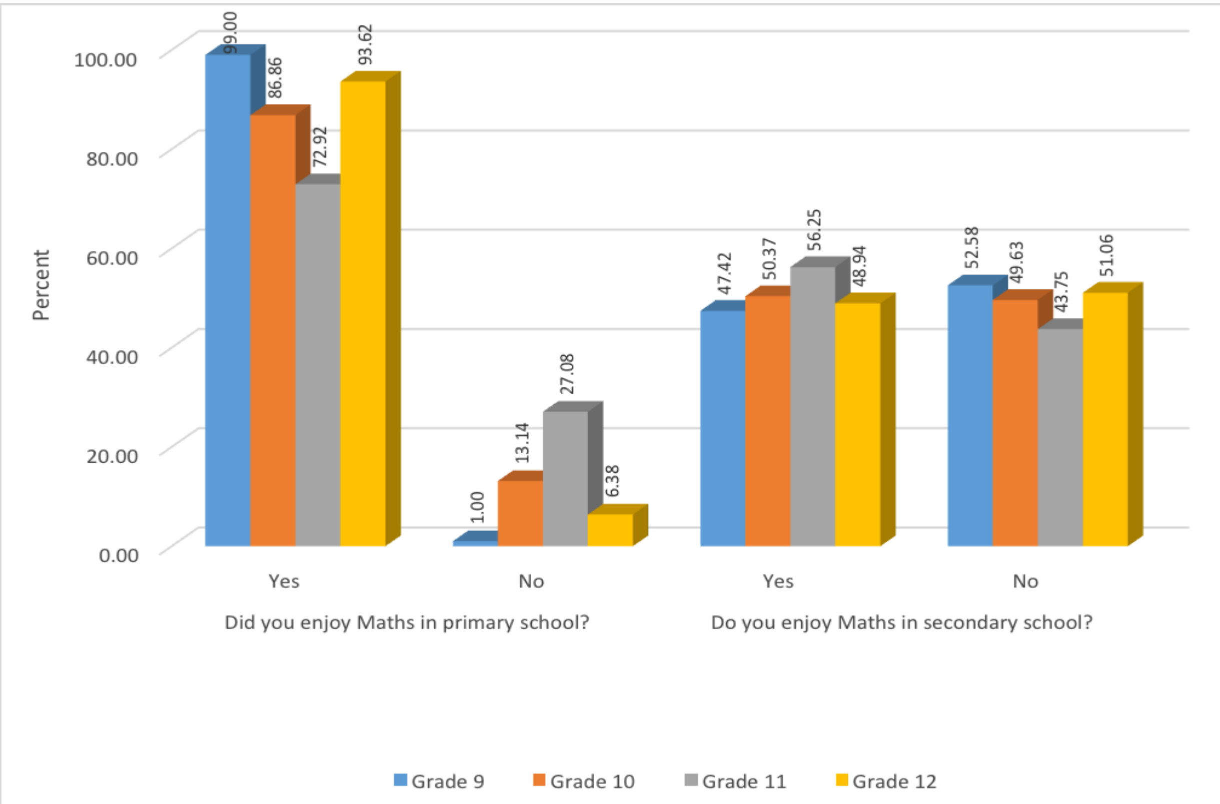
"My Maths teacher knows the topics and teaches us very well." Learner 1.

"My Maths teacher explains the sections and I understand." Learner 2.

"The other children in class are not disruptive and we can pay attention." Learner 3.

Learners affirmed that the quality of teaching, having a knowledgeable teacher and being in well-disciplined class have a positive impact on them.

Figure 5.2: Level of enjoyment of primary and secondary school Mathematics



Teachers who are encouraging and knowledgeable can also help learners overcome a sense of negativity regarding Mathematics. This leads to a plausible reason that learners' interest in Mathematics at secondary school deteriorates because the transition from primary to secondary school presents them with challenges. Fadzil and Saat (2014: 215) state that during early transition, learners developed a gap in relating to the level of the curriculum in Mathematics they had learned in primary school. It may be construed that from the findings in Figure 5.2 there is an issue of backwardness or gaps in the transition process from primary to secondary school. It must also be noted that the 34% of the Grade 11 learners were from schools that were located in affluent areas. The location of learners may also contribute to their academic performance.

5.6.2 Section Analysis

The following section analyses the scoring patterns of the respondents per variable per section. In section C, the levels of disagreement (negative statements) were collapsed to show a single category of "Disagree". A similar procedure was followed for the levels of agreement (positive statements). The results are first presented using summarized percentages for the variables that constitute each section. Results are then further analyzed according to the importance of the statements.

5.7 Section B – About your primary school Mathematics

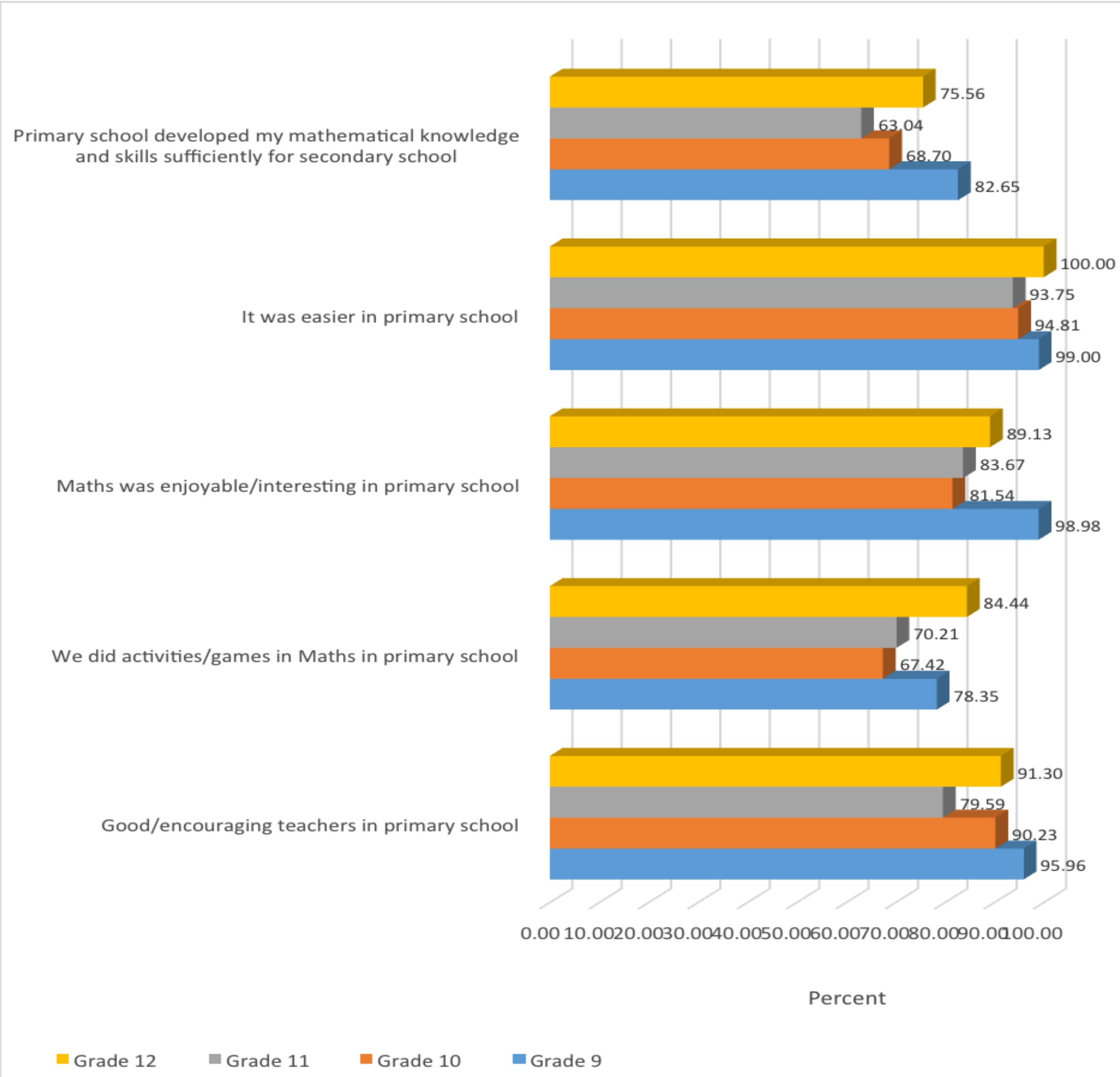
The table below summarises the scoring patterns.

Table 5.7: Scoring patterns

	Grade 9		**Grade 10**		**Grade 11**		**Grade 12**	
	Yes	No	Yes	No	Yes	No	Yes	No
Good/encouraging teachers in primary school	95.96	4.04	90.23	9.77	79.59	20.41	91.30	8.70
We did activities/games in Maths in primary school	78.35	21.65	67.42	32.58	70.21	29.79	84.44	15.56
Maths was enjoyable/interesting in primary school	98.98	1.02	81.54	18.46	83.67	16.33	89.13	10.87
It was easier in primary school	99.00	1.00	94.81	5.19	93.75	6.25	100.0	0.00
Primary school developed my mathematical knowledge and skills sufficiently for secondary school	17.35	82.65	31.30	68.70	36.96	63.04	24.44	75.56

This section deals with reasons why secondary school learners liked Mathematics at primary school. Figure 5.3 respresents the positive (Yes) scores from the table above for the first four statements and the first graph in the figure below represents the negative (No) of the last statement. The negative (No) scores is the difference as in the table. Majority learners from grades 9 to 12 found Mathematics to be easy in primary school. They also concurred that activities such as games in Mathematics were common for learners to be engaged in. Learners acknowledged that their primary school Mathematics was watered down and fairly simple. This ties up with the findings of Tilleczek (2007: 67) that the increase in content depth and adaptations to new pedagogies presents difficulties that may lead to achievement loss.

Figure 5.3: About primary phase Mathematics



The following patterns are observed:

- Grades 9 and 12 have the higher scoring agreement patterns.
- The statement relating to mathematics being easier in primary school has the highest average scoring pattern (96.9%).
- The statement with the lowest level of agreement was "Primary school developed my mathematical knowledge and skills sufficiently for secondary school" (72.5%).

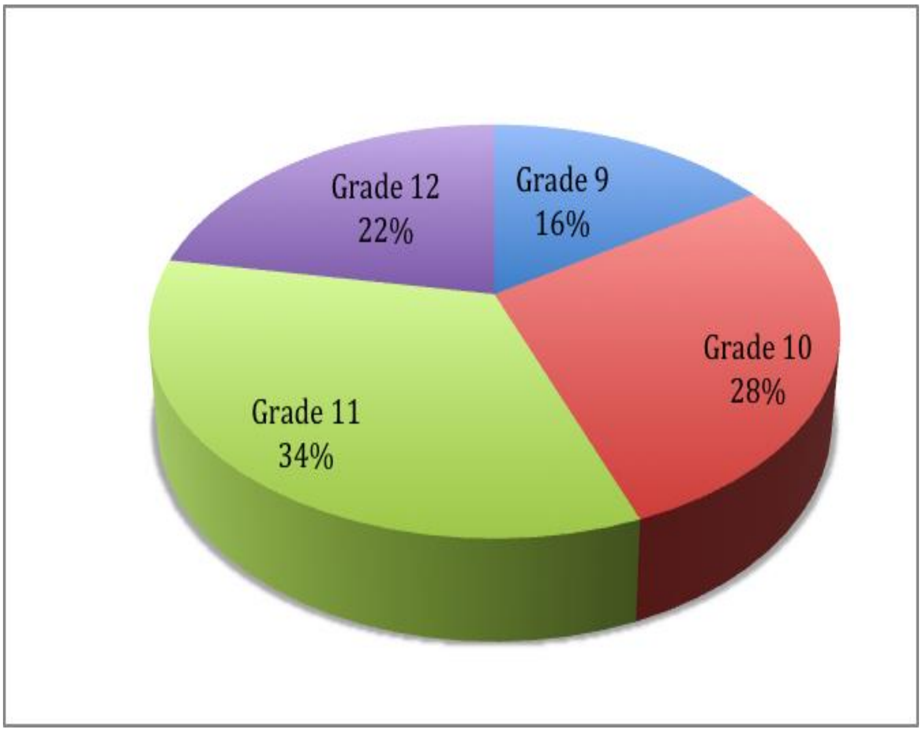
Majority of the respondents indicated that their SKAVs developed in Mathematics in the primary school did not prepare them for secondary school Mathematics. A possible explanation for this is that perhaps the curriculum was simplistic enough in primary school. This could be a possible explanation why learners found primary school Mathematics to be very easy. The statements below highlight what the learners were referring to during the interview:

"Primary school Maths was so easy." Learner 1.

"The Maths we learnt in primary school was so fun and easy." Learner 2.

"Maths I learned in Grade 7 does not help in Grade 9…it is hard now." Learner3.

Figure 5.4: Primary school developed my mathematical knowledge and skills sufficiently for secondary school



The pie graph indicates that a small percentage of learners: 16% in Grade 9, 28% in Grade 10, 34% in Grade 11 and 22% in Grade 12 mentioned that primary school developed their mathematical knowledge and skills sufficiently for secondary school. The majority of Grade 9 to 12 learners affirmed that primary school Mathematics did not develop their mathematical knowledge and skills sufficiently for secondary school. Grade 9 constituted the lowest percentage of learners who responded that primary school Mathematics developed their mathematical knowledge and skills sufficiently. They are the learners who completed their primary education most recently as compared to Grades 10, 11 and 12 learners. It could be construed that the Grade 9 learners will remember their primary school experiences better than the learners in Grades 10 to 12 in the FET phase. In light of the above findings where learners stated that primary school Mathematics did not prepare them for secondary school points to the findings made by Spaull and Kotze (2015: 13) that learners who have acquired learning deficits early on in their schooling careers that are the root cause of under-performance in later years.

Figure 5.5: Mathematics was easier in primary school

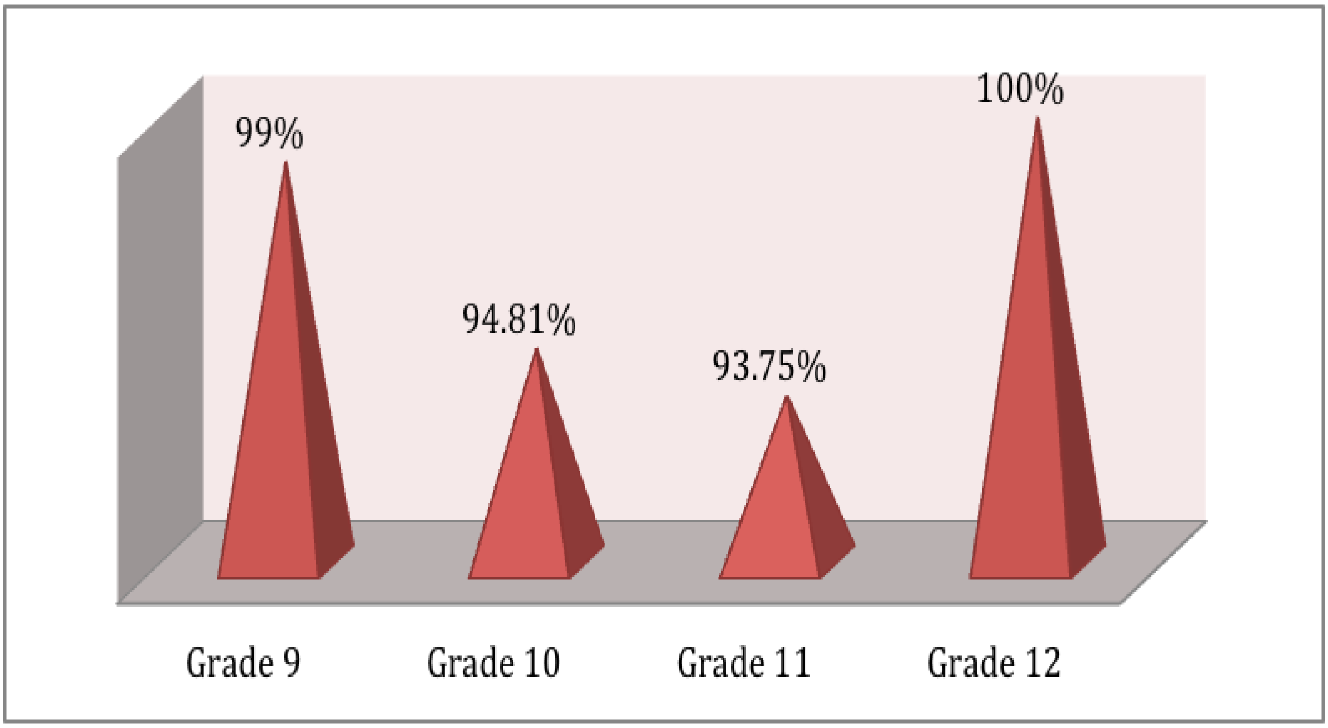


Figure 5.5 indicates that the majority of learners from Grades 9 to 12 verified that Mathematics was easier in primary school than secondary school. Ninety-nine percent of Grade 9 learners, 94.81% of Grade 10 learners, 93.75% of Grade 11 learners and 100% of Grade 12 learners found primary school Mathematics to be easy. Three secondary school learners mentioned the following during the interview:

"*I did so well in primary school and now I can't get a pass mark of 30%.*" Learner 1.

"The Maths we did in primary school was so easy….everybody used to pass." Learner 2.

"Assessments used to be so easy and fun …making posters….cutting and making shapes." Learner 3.

It can be concluded from the above statements expressed by learners that they were accustomed to easy and simplistic tasks in primary school. Therefore when they enter secondary school they get a rude awakening when their performance in Mathematics deteriorates. Learners then develop a mindset that Mathematics at secondary school is meant to be difficult. This finding is in keeping with Moodley's (2011: 66) assertion that numerous learners experienced some forms of negativity that contributed to their negative perceptions of Mathematics. Difficulties experienced in Mathematics at secondary school may be characterized by the development of negative attitudes towards Mathematics. To determine whether the scoring patterns per statement were significantly different per option, a chi square test was conducted. The null hypothesis claims that similar numbers of respondents scored across each option for each statement (one statement at a time). The alternate states that there is a significant difference between the levels of agreement and disagreement. The (overall) results are shown in Table 5.8.

Table 5.8: Chi-square test score

	Good/encouraging teachers in primary school	We did activities/games in Maths in primary school	Maths was enjoyable/ interesting in primary school	It was easier in primary school	Primary school developed my mathematical knowledge and skills sufficiently for secondary school
Chi-Square	214.755[a]	71.031[a]	188.882[a]	287.467[a]	68.450[a]
df	1	1	1	1	1
Asymp. Sig.	.000	.000	.000	.000	.000

The highlighted sig. values (p-values) are less than 0.05 (the level of significance). These values are highlighted in yellow. This implies that the distributions were not similar. That is, the difference between the Yes scores and the No scores per statement was significant. The Pearson Chi-square test was employed to determine whether there was a statistically significant relationship between the variables (rows vs. columns). These variables are used to explain any statistically significant relationships between the two groups. According to Tuckman (1978: 262) these variables can be used for almost any number of independent variables.

The large majority of learners, namely: 93% from Grade 9; 77.6% from Grade10; 70.83% from Grade 11 and 86.67 % from Gade 12 mentioned that Maths was not boring in primary school. A significant majority of learners, namely: 96.94% from Grade 9; 88.33% from Grade10; 87.50% from Grade 11 and 88.64% from Grade 12 stated that they did not find Maths difficult in primary school.

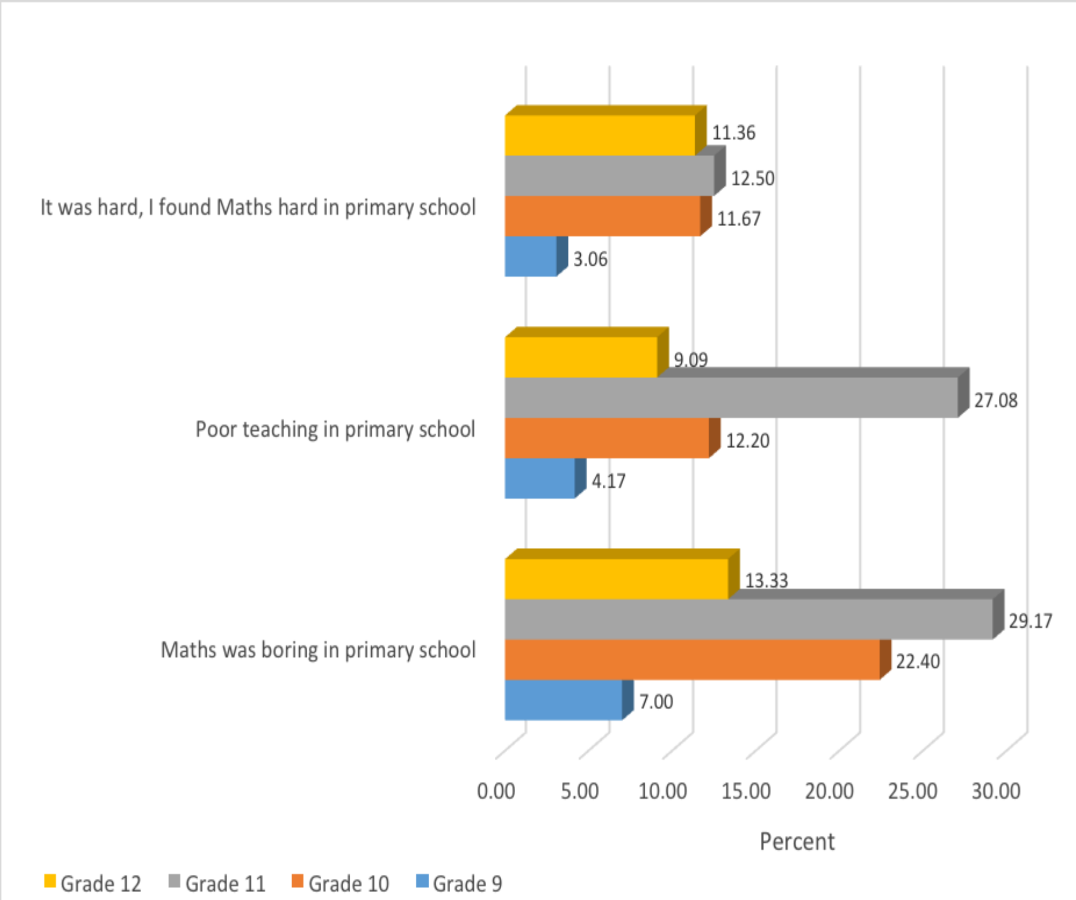
Table 5.9: Why learners did not like Mathematics

	Grade 9		Grade 10		Grade 11		Grade 12	
	Yes	No	Yes	No	Yes	No	Yes	No
Maths was boring in primary school	7.00	93.00	22.40	77.60	29.17	70.83	13.33	86.67
Poor teaching in primary school	4.17	95.83	12.20	87.80	27.08	72.92	9.09	90.91
It was hard, I found Maths hard in primary school	3.06	96.94	11.67	88.33	12.50	87.50	11.36	88.64

The learners, in this research study, mentioned that the primary school Mathematics curriculum is easy and simple for them. Majority of the respondents ranging between 70% to 93% stated that Mathematics was not boring in primary school although they found the subject to be easy. This provides a possible answer to the research question, namely: to investigate the readiness of learners in Mathematics for the secondary phase. The possible answer is that the majority of the respondents are not equipped for the changes they encounter in secondary school Mathematics.

A similar analysis for why learners did not like Mathematics is illustrated in Figure 5.6, which only reflects the “Yes” responses.

Figure 5.6: Why learners did not like Mathematics in primary school



On average, less than 10% found Mathematics difficult at primary school. There were higher responses by the senior learners regarding the poor teaching which resulted in the lessons being boring (Spearman's correlation value = 0.329, $p = 0.000$). Learners stated the following in the interview:

"The teacher used to ask us to call out our answers and not do the working on the board." Learner 1.

"Sometimes my teacher used to call the clever children to work the sums on the board… maybe she did not know the working and she did not explain." Learner 2.

The (overall) chi-square tests per statement also indicated that the differences between Yes and No were significant (more No's than Yes's) ($p < 0.05$) in Table 5.10. This points out to the possibility that the Mathematics assessments in primary school was simple for the learners which may be a possible reason for learners finding primary school Mathematics very easy. This also links to the findings of

Slavin *et al.* (2009: 841) that schools are failing to develop learners' mathematical knowledge and skills sufficiently between the ages of seven and eleven.

Table 5.10: Chi-square tests showing differences between yes and no

	Maths was boring in primary school	Poor teaching in primary school	It was hard, I found Maths hard in primary school
Chi-Square	136.050	183.669	208.116
df	1	1	1
Asymp. Sig.	.000	.000	.000

The table below summaries the responses to "I think I will be successful in a career that requires mathematical ability."

Table 5.11: Successful in a career in Mathematics

		Grade 9	Grade 10	Grade 11	Grade 12	Total
I think I will be successful in a career that requires mathematical ability?	Yes	43.00	37.96	37.50	46.81	35.19
	No	57.00	62.04	62.50	53.19	64.81

The majority of the secondary school learners in this study doubted their success in Mathematics in the future. Fifty seven percent of Grade 9 learners, 62.04 % of Grade 10 learners, 53.19% of Grade 11 learners and 64.81% of Grade 12 learners thought that they will not be successful in a career that required Mathematics. Majority of the secondary school learners who participated in this study had negative perceptions of a career that required Mathematics.

Table 5.12: Test Statistics

	I think I will be successful in a career that requires mathematical ability?
Chi-Square	9.446
df	1
Asymp. Sig.	.002

The chi-square test indicates the overall scoring patterns, highlighted in Table 5.12. The (overall) levels of Yes are significantly different from No responses ($p = 0.02$).

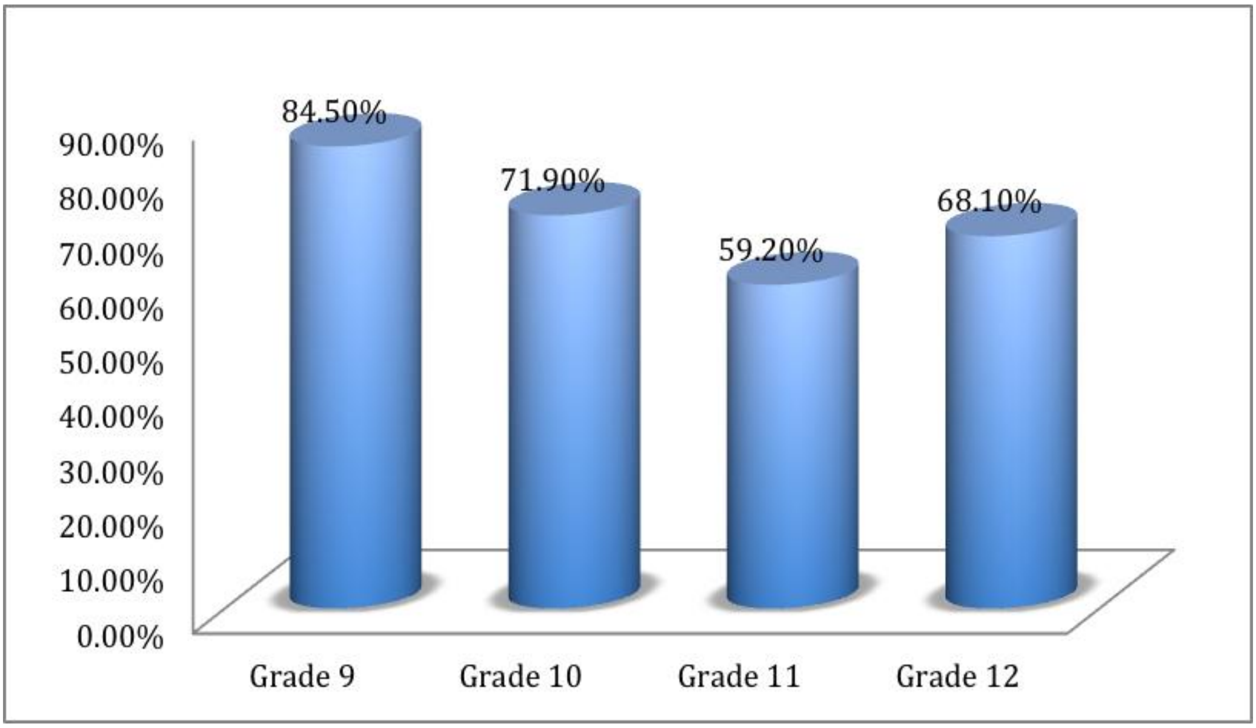
5.8 Section C – Learner self-efficacy in Mathematics

Table 5.13: Learner self-efficacy in Mathematics

What grade are you in?		Grade 9		Grade 10		Grade 11		Grade 12	
		Count	Column N %	Count	Column N %	Count	Column N %	Count	Column N %
I am good at Maths	Agree	25	25.8%	55	40.7%	22	44.9%	22	46.8%
	Not Sure	49	50.5%	54	40.0%	21	42.9%	18	38.3%
	Disagree	23	23.7%	26	19.3%	6	12.2%	7	14.9%
I do not enjoy Maths	Agree	24	24.2%	37	27.4%	12	24.5%	14	29.8%
	Not Sure	22	22.2%	31	23.0%	14	28.6%	12	25.5%
	Disagree	53	53.5%	67	49.6%	23	46.9%	21	44.7%
Primary school Maths was not challenging	Agree	75	78.1%	104	76.5%	31	63.3%	35	74.5%
	Not Sure	12	12.5%	21	15.4%	14	28.6%	6	12.8%
	Disagree	9	9.4%	11	8.1%	4	8.2%	6	12.8%
Maths that I learnt in primary school does not help in the secondary school	Agree	82	84.5%	97	71.9%	29	59.2%	32	68.1%
	Not Sure	11	11.3%	21	15.6%	10	20.4%	10	21.3%
	Disagree	4	4.1%	17	12.6%	10	20.4%	5	10.6%
Maths that I learn in secondary school is different from the Maths I learnt at primary school	Agree	93	93.0%	112	82.4%	32	65.3%	35	74.5%
	Not Sure	5	5.0%	12	8.8%	5	10.2%	9	19.1%
	Disagree	2	2.0%	12	8.8%	12	24.5%	3	6.4%
I find Maths too difficult for me	Agree	40	40.0%	40	30.1%	9	18.4%	10	21.3%
	Not Sure	23	23.0%	30	22.6%	11	22.4%	12	25.5%
	Disagree	37	37.0%	63	47.4%	29	59.2%	25	53.2%
I am confident of myself when I do Maths	Agree	37	38.1%	67	50.0%	24	50.0%	19	40.4%
	Not Sure	31	32.0%	39	29.1%	13	27.1%	15	31.9%
	Disagree	29	29.9%	28	20.9%	11	22.9%	13	27.7%
Maths is dull and boring.	Agree	13	13.4%	35	26.1%	11	22.4%	10	22.7%
	Not Sure	17	17.5%	19	14.2%	10	20.4%	6	13.6%
	Disagree	67	69.1%	80	59.7%	28	57.1%	28	63.6%
My teacher makes me feel that Maths is useful in everyday life.	Agree	82	82.0%	94	69.1%	36	76.6%	36	76.6%
	Not Sure	6	6.0%	20	14.7%	4	8.5%	5	10.6%
	Disagree	12	12.0%	22	16.2%	7	14.9%	6	12.8%
I rarely use the Maths I learn at school in everyday life	Agree	39	39.4%	59	45.0%	23	46.9%	19	42.2%
	Not Sure	26	26.3%	21	16.0%	6	12.2%	10	22.2%
	Disagree	34	34.3%	51	38.9%	20	40.8%	16	35.6%
Overall I find the Maths lessons at school interesting.	Agree	60	61.2%	71	53.4%	29	60.4%	26	56.5%
	Not Sure	21	21.4%	27	20.3%	11	22.9%	8	17.4%
	Disagree	17	17.3%	35	26.3%	8	16.7%	12	26.1%
Learning Maths is too stressful.	Agree	70	70.7%	56	41.5%	16	34.0%	20	43.5%
	Not Sure	12	12.1%	23	17.0%	8	17.0%	9	19.6%
	Disagree	17	17.2%	56	41.5%	23	48.9%	17	37.0%
I would avoid studying Maths after matric	Agree	26	26.3%	42	30.9%	16	33.3%	16	34.0%
	Not Sure	29	29.3%	24	17.6%	8	16.7%	12	25.5%
	Disagree	44	44.4%	70	51.5%	24	50.0%	19	40.4%
My teacher thinks that I can do well in Maths.	Agree	57	57.6%	70	51.9%	32	66.7%	34	73.9%
	Not Sure	20	20.2%	42	31.1%	13	27.1%	11	23.9%
	Disagree	22	22.2%	23	17.0%	3	6.3%	1	2.2%
Maths is my worst subject	Agree	41	41.0%	50	37.3%	7	14.6%	9	19.1%
	Not Sure	15	15.0%	13	9.7%	9	18.8%	6	12.8%
	Disagree	44	44.0%	71	53.0%	32	66.7%	32	68.1%

This section is a summarized scoring of learner self-efficacy in Mathematics. Results indicate that 70.7% of Grade 9; 41.5% of Grade 10; 34.0% of Grade 11; and 43.5% of Grade 12 learners stated that learning Mathematics is too stressful. There are very important trends that had a negative impact on learners as they progressed into secondary school. A few pertinent trends are graphically represented, whilst the others may be viewed from responses in Table 5.13. Learners' conceptions of the subject; perceptions of themselves; and of their relationship to Mathematics are a few problems learners encounter. Many learners admitted to a dislike and having negative perspectives of Mathematics. A smaller percentage of learners at secondary school mentioned that they enjoy Mathematics at secondary school, that is: 24.2% of Grade 9 learners, 27.4% of Grade 10 learners, 24.5% of Grade 11 learners and 29.8% of Grade 12 learners. In some instances learners' mathematical self-concepts were influenced by the experiences and the attitudes of teachers.

Figure 5.7: Maths that I learnt in primary school does not help in the secondary School



The findings in Figure 5.7 reflects that the learning of Mathematics is affected by their mathematical abilities and the attitudes, beliefs and feelings they harbour towards Mathematics as this was discussed in the previous paragraph whereby learners have some negative responses towards Mathematics in the secondary school. Figure 5.7 indicates that 84.5% of Grade 9 learners, 71.9% of Grade 10 learners, 59.2% of Grade 11 learners and 68.1% of Grade 12 learners stated that the Mathematics they learnt in primary school does not help in secondary school. The skills learnt in primary school such as addition and subtraction obviously does help the learners in secondary school.

The researcher having taught Mathematics at primary and secondary schools, could also attest to the view of the learners that some of aspects learnt at primary school is simple and not rigorous enough to make learners think at a higher level. Maths anxiety is also indicated as a negative factor, regardless of actual ability and that literature on Mathematics anxiety by Moodley (2011: 23) has given support to the existence of a negative relationship between Mathematics self-efficacy and performance.

Figure 5.8: Primary school Mathematics was easy

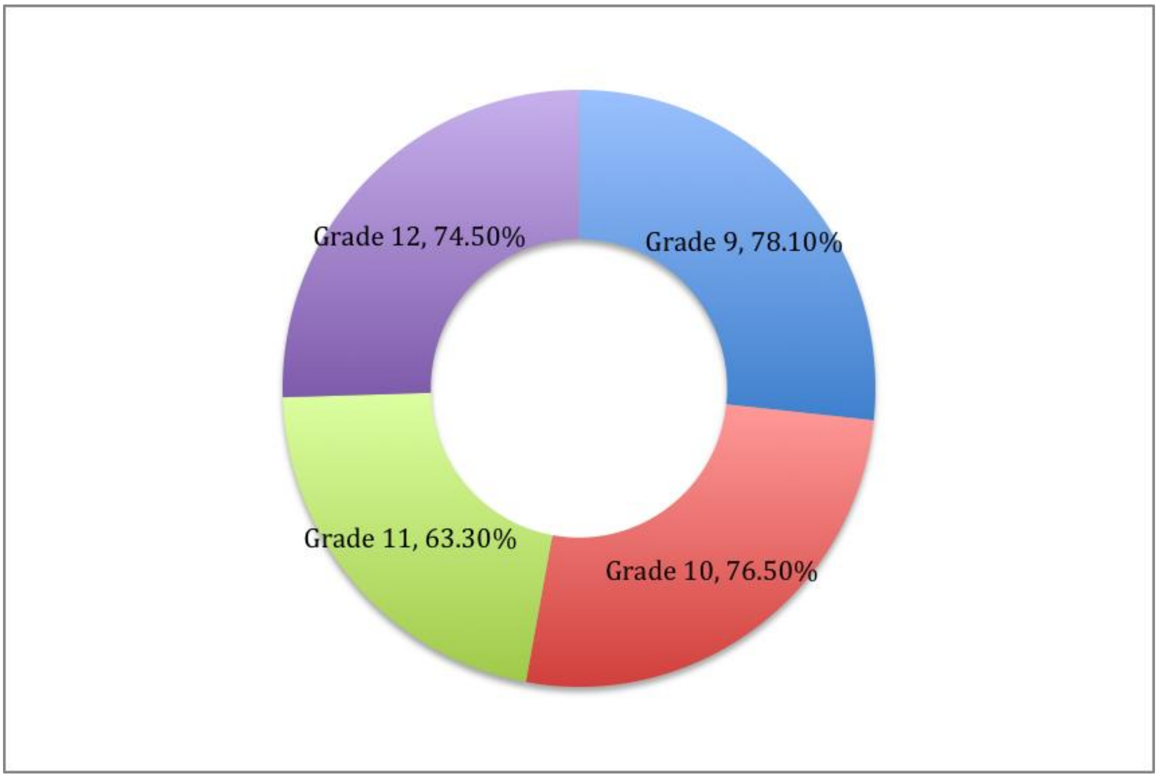


Figure 5.8 indicates that the majority of secondary school learners concurred that the Mathematics they learnt in primary school did not prepare them sufficiently for

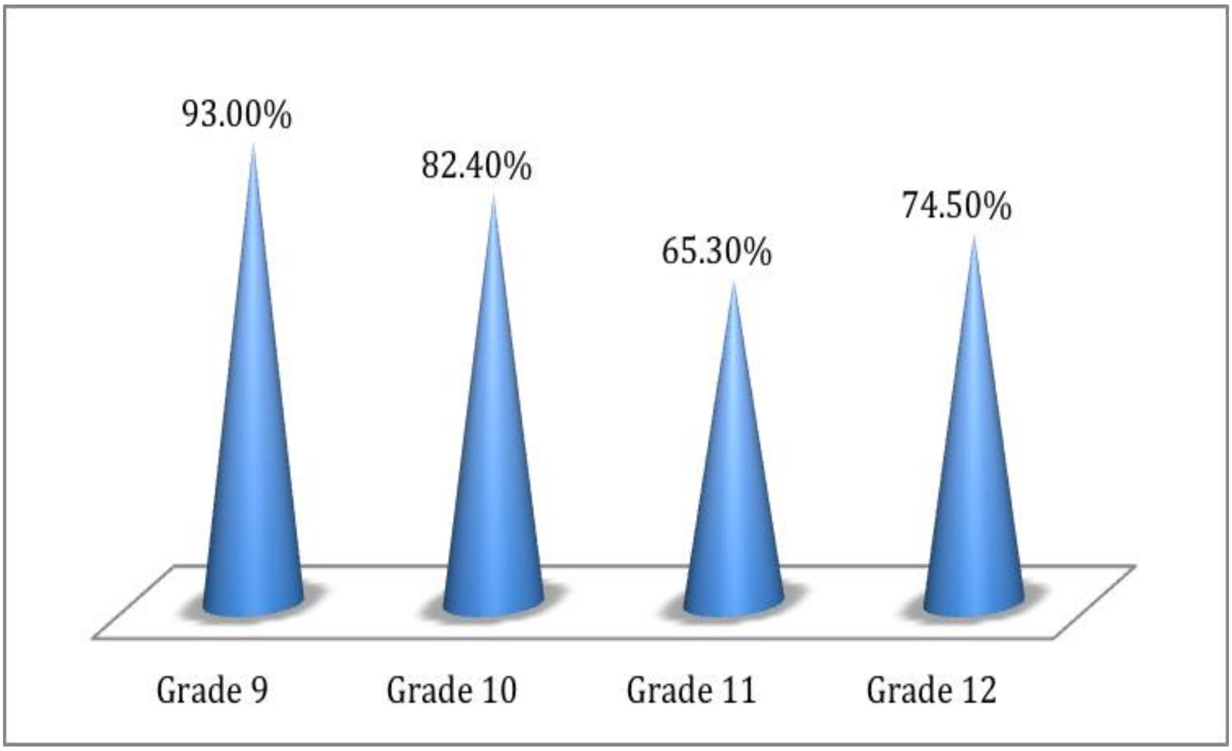
secondary school. Results indicate that 78.1% of Grade 9 learners, 76.5% of Grade 10 learners; 63.3% of Grade 11 learners and 74.5 % of Grade 12 learners confirmed that primary school Mathematics is not rigorous enough and as a result did not assist them much in secondary school. These were a few statements from secondary school learners:

"We learnt bonds and tables everyday…but now we use calculators." Learner 1.

"Division sums were irritating…you can get answers from a calculator." Learner 2.

Although Mathematics in primary school provides some grounding in learners, it is imperative that the Mathematics curriculum includes higher-order learning in Mathematics. According to Resnick (1987: 8) higher-order thinking involves the learning of complex judgmental skills such as critical thinking and problem solving and that higher-order thinking is more difficult to learn or teach but also more valuable because such skills are more likely to be usable in the future years. This confirm with Reddy *et al's.* (2015: 5) finding that emphasis needs to be placed on improving the fundamentals of instruction in earlier grades in order to reduce the large number of learners who lack basic knowledge of Mathematics.

Figure 5.9: Maths that I learn in secondary school is different from the Maths I learnt at primary school



Majority of the respondents from grades 9 to 12 concurred that the Mathematics they learn in secondary school is different from the Mathematics they learnt at primary school. This finding provides the answer to the research question that there are gaps between primary and secondary phase Mathematics education. This finding alludes to the suggestion of Paul (2014: 209) that learners' experienced difficulties in coping when they transitioned from primary to secondary school due to curriculum content and it took time for them to adapt to secondary school Mathematics curriculum.

The overall chi-square tests in Table 5.14 indicate the following: All of the p-values are less than 0.05 (the level of significance). This means that the levels of agreement, disagreement and uncertainty, per statement, were significantly different. Learners from grades 9 to 12 expressed negativity about secondary school Mathematics. This points to another research question where learners' perceptions, expectations and experiences of Mathematics at secondary school level changes dramatically from primary school perceptions expectations and experiences. This finding coincides with findings by Kay and Knaack (2008: 273) that the transition into secondary school is marked by increased disengagement and declining motivation amongst learners.

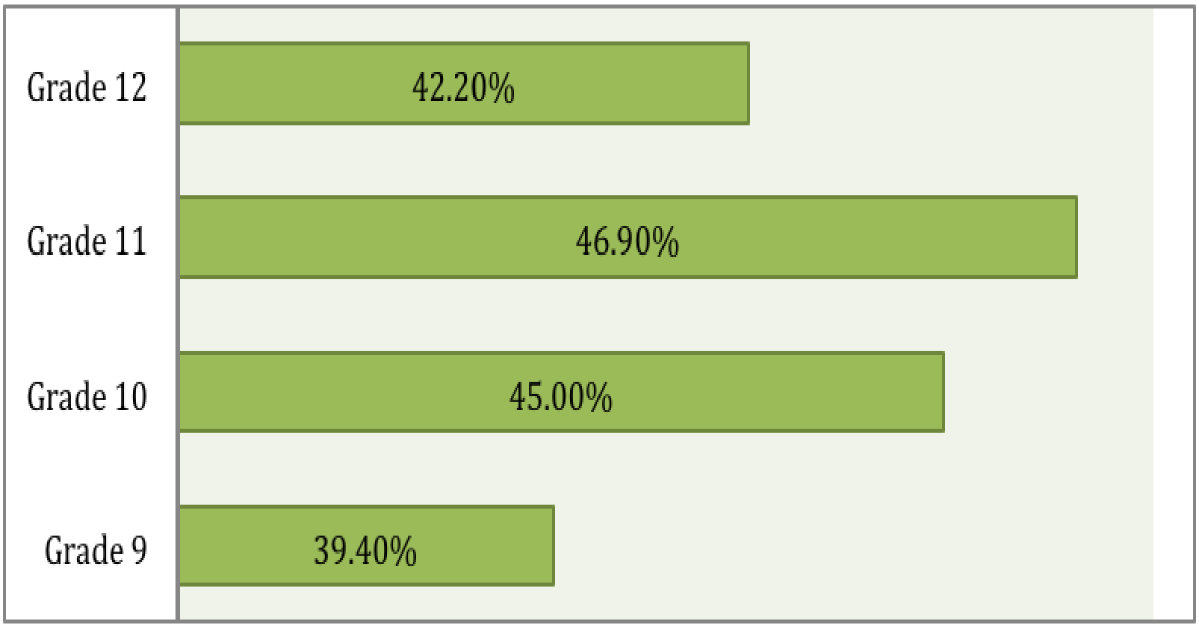
Table 5.14: Chi square tests

	Chi-Square	df	Asymp. Sig.
I am good at Maths	32.22	2	.000
I do not enjoy Maths	40.055	2	.000
Primary school Maths was not challenging	254.933	2	.000
Maths that I learnt in primary school does not help in secondary school	235.415	2	.000
Maths that I learn in secondary school is different from the Maths I learnt at primary school	352.813	2	.000
I find Maths too difficult for me	29.295	2	.000
I am confident of myself when I do Maths	21.613	2	.000
Maths is dull and boring.	126.685	2	.000
My teacher makes me feel that Maths is useful in everyday life.	260.345	2	.000
I rarely use the Maths I learn at school in everyday life	29.796	2	.000
Overall I find the Maths lessons at school interesting.	83.637	2	.000
Learning Maths is too stressful.	55.725	2	.000
I would avoid studying Maths after matric	33.436	2	.000
My teacher thinks that I can do well in Maths.	102.299	2	.000
Maths is my worst subject	84.426	2	.000

Differing percentages of between 39.4% to 46.9% of secondary school learners agree that they will seldom make use of the Mathematics they learn at school in their daily lives. This is illustrated in Figure 5.10.

Two respondent stated the following:
"We don't use trigonometry…I don't know why we have to struggle and learn this... trig does not help us in our daily lives!'. Learner 1.
"Also we don't make use of circle geometry in our everyday lives." Learner 2.

Figure 5.10: I rarely use the Mathematics I learn at school in everyday life



Learners do not see the relevance in what is expected of them to learn at secondary school to the real world. This reflects a similar concern by Glatthorn and Jailall (2012: 32) that the Mathematics curriculum should provide for individual differences and it should selectively integrate subject matter which learners are familiar with in their daily lives.

5.9 Section D – My Mathematics teacher

This section compares the level of expectancy with the actual experience of the learner's Mathematics teacher(s) in Table 5.15.

Table 5.15: My Mathematics Teacher

		What grade are you in?															
		Grade 9				Grade 10				Grade 11				Grade 12			
		Agree		Disagree		Agree		Disagree		Agree		Disagree		Agree		Disagree	
		Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %
Polite, courteous and kind	Expectation	91	91.9	8	8.1	118	87.4	17	12.6	46	93.9	3	6.1	40	85.1	7	14.9
	Experience	57	58.2	41	41.8	69	51.1	66	48.9	35	71.4	14	28.6	41	87.2	6	12.8
Knowledgeable and confident in Maths	Expectation	97	97.0	3	3.0	128	94.1	8	5.9	46	95.8	2	4.2	44	93.6	3	6.4
	Experience	81	82.7	17	17.3	82	60.7	53	39.3	39	79.6	10	20.4	40	85.1	7	14.9
Helpful when I ask for help	Expectation	90	90.0	10	10.0	128	94.1	8	5.9	45	91.8	4	8.2	44	95.7	2	4.3
	Experience	46	46.5	53	53.5	82	60.3	54	39.7	37	75.5	12	24.5	41	89.1	5	10.9
Enthusiastic and encourages us in class	Expectation	92	94.8	5	5.2	111	83.5	22	16.5	45	91.8	4	8.2	41	87.2	6	12.8
	Experience	73	76.8	22	23.2	59	44.0	75	56.0	28	57.1	21	42.9	38	80.9	9	19.1
Explains the lessons and I understand	Expectation	89	94.7	5	5.3	112	83.0	23	17.0	43	89.6	5	10.4	46	97.9	1	2.1
	Experience	44	46.8	50	53.2	62	45.6	74	54.4	29	60.4	19	39.6	36	76.6	11	23.4
My test papers are marked timeously and my teacher reviews the test	Expectation	88	91.7	8	8.3	121	89.6	14	10.4	45	95.7	2	4.3	45	97.8	1	2.2
	Experience	40	41.2	57	58.8	87	64.4	48	35.6	38	80.9	9	19.1	45	97.8	1	2.2

In every statement about the learners' Mathematics teachers, they have a higher expectation and their actual experience is lower. However this does not impact greatly on the statement: 'expect the Mathematics teachers to be knowledgeable and confident' because the difference is rather low. Ninety-seven percent of the Grade 9 learners expect their Mathematics teachers to be knowledgeable and confident in Mathematics and 82.7% experience this. Ninety-four point one percent of the Grade 10 learners expect their Mathematics teachers to be knowledgeable and confident in Mathematics and 60.7% experience this. Ninety-five point eight percent of the Grade 11 learners expect their Mathematics teachers to be knowledgeable and confident in Mathematics and 79.6% experience this. At Grade 12 level, ninety-three point six percent of the learners expect their Mathematics teachers to be knowledgeable and confident in Mathematics and 85.1% experience this.

The expectancy and actual experience for ‘the teacher explains the lessons and I understand’ has a slightly different scenario. Ninety-four point seven percent of the Grade 9 learners expect their Mathematics teachers to explain the lesson and they should understand instead 46.8% experience this. Eighty-three point five percent of the Grade 10 learners expect their Mathematics teachers to explain the lesson and they should understand instead 45.6% experience this. Eighty-nine point six percent of the Grade 11 learners expect their Mathematics teachers to explain the lesson and they should understand instead 60.4% experience this. Ninety-seven point nine percent of the Grade 12 learners expect their Mathematics teachers to explain the lesson and they should understand instead 76.6% experience this. More than 50% of Grade 9 and Grade 10 learners have higher expectation and their actual experience is lower for ‘the teacher explains the lessons and I understand’.

Figure 5.11: Experience and expectation

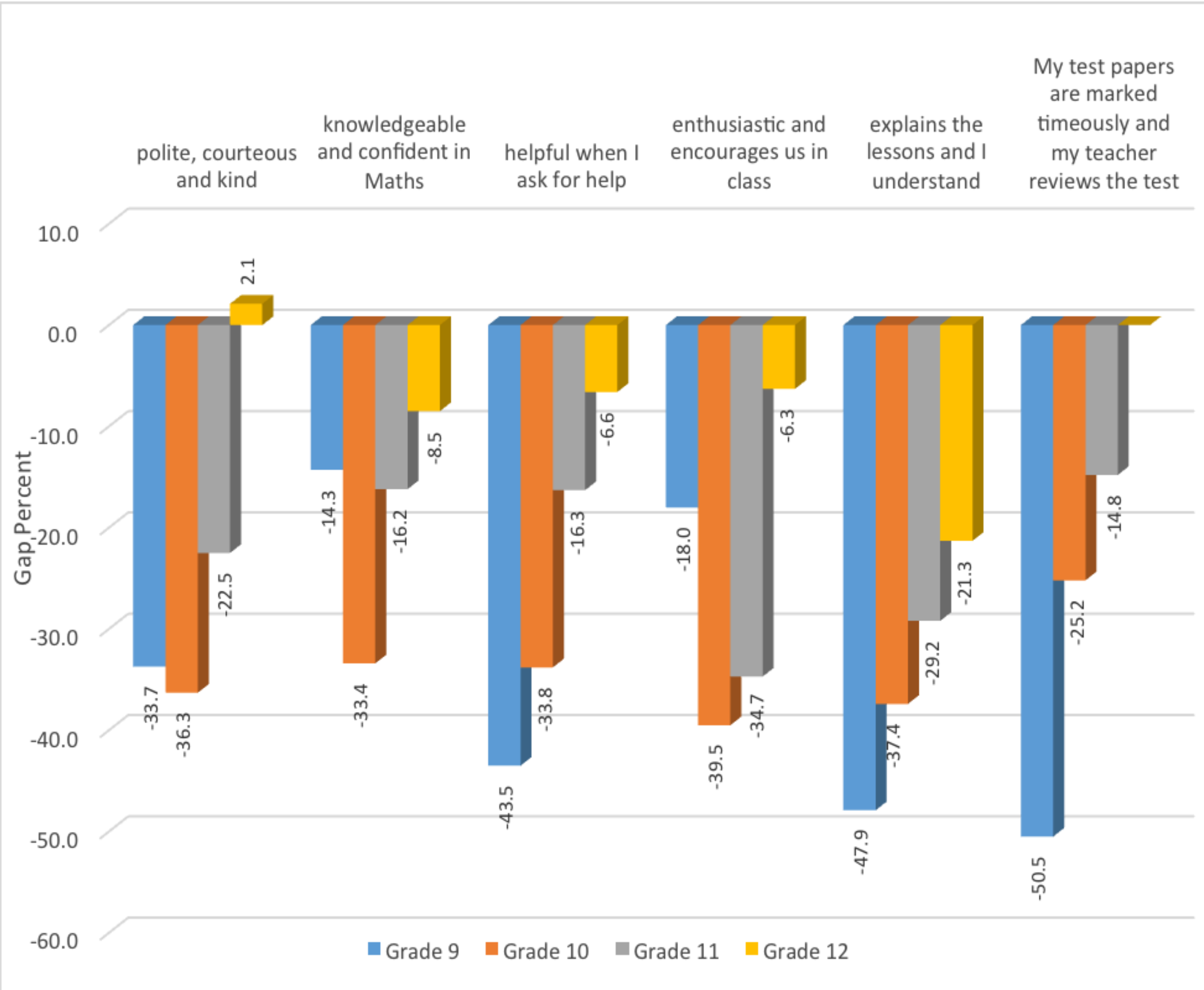


Figure 5.11 below indicates a percent gap difference between experience and expectation. Positive differences imply that the learners experience is better than what they expect, and vice versa. In the opinion of the learners, they are not getting "value for money" in certain aspects (as illustrated in Figure 5.11). Grades 9 and 10 seem to have the largest contributions to the gaps. Grades 9 and Grade 10 learners have similar notions that their experiences are negative to that of their expectations. -25.1 indicates that they do not get the help from their Mathematics teachers as expected. There is only one positive gap for grade 12 learners who believe that their teachers are polite, courteous and kind. All of the other gaps are negative, implying that the experience does not match what learners expect to get. The Grade 11 and Grade 12 learners' gap scores are lower than Grade 9 and Grade 10 learners' expectations for most of the variables.

Two teachers teaching Mathematics in Grade 9 stated the following in the interview:
"We do not have sufficient developmental workshops." Teacher 1.
"Policies are just thrust at us…. and it has to be implemented." Teacher 2.
Although learners agreed that their teachers are knowledgeable and confident in Mathematics; ongoing professional development will improve teaching and thus improve the level of understanding in learners. CPTD should be conducted regularly to develop and improve quality teaching and learning.

5.10 Hypothesis testing

The traditional approach to reporting a result requires a statement of statistical significance. A p-value is generated from a test statistic. A significant result is indicated with "$p < 0.05$". These values are highlighted with a *.
A second Chi square test was performed to determine whether there was a statistically significant relationship between the variables (rows vs columns).
The null hypothesis states that there is no association between the two. The alternate hypothesis indicates that there is an association.
For example: The p-value between "Did you enjoy Maths in primary school?" and "Good/encouraging teachers in primary school" for Grade 9 is 0.000. This means that there is a significant relationship between the variables highlighted in yellow. That is,

the level of enjoyment of Mathematics in primary school did depend on the nature of the encouragement that learners received from their teachers.

All values without an * (or p-values more than 0.05) do not have a significant relationship.

Bivariate correlation was also performed on the (ordinal) data. (Correlations table are too large to print).

The results indicate the following patterns:

Positive values indicate a directly proportional relationship between the variables and a negative value indicates an inverse relationship. All significant relationships are indicated by a * or **.

For example, the correlation value between "Maths was enjoyable/interesting in primary school" and "Good/encouraging teachers in primary school" is 0.403**. This is a directly related proportionality. Learners indicate that the more teachers encourage them at primary school, the more enjoyable Mathematics was, and vice versa.

The correlation value between "Maths was easier in primary school" and "Maths was enjoyable in primary school" is 0.265**. Learners indicate that the more enjoyable Mathematics was at primary school, the easier it was and vice versa.

Another correlation value between "I think I will be successful in a career that requires mathematical ability?" and "Maths was enjoyable in primary school" is 0.387**. Learners indicate that the more enjoyable Mathematics was at primary school, the more successful they will be in a career that requires mathematical ability.

Negative values imply an inverse relationship. That is, the variables have an opposite effect on each other.

That is, as one increases, the other decreases.

For example, the correlation value between "Maths was enjoyable/interesting in primary school" and "Maths was boring in primary school" is -0.407*. That is, the more enjoyable Mathematics was in primary school, the less boring it was.

The correlation value between "Poor teaching in primary school" and "Primary school developed my mathematical knowledge and skills sufficiently for secondary school" is –154*. That is, the poorer the teaching in primary school was, the more insufficient learners' mathematical knowledge and skills for secondary school.

Another correlation value exists between "My teacher makes me feel that Maths is useful in everyday life" and "Maths is dull and boring" at -219*. That is, the more the teacher makes the learner feel that Maths is useful in everyday life, the lesser dull and boring Mathematics is.

The correlation value between "Learning Maths is too stressful" and "I am confident of myself when I do Maths" is -405*. That is, the more stressful Mathematics is, the lesser the learners' confidence when they do Mathematics.

Another correlation value exists between "Maths that I learn in secondary school is different from the Maths I learnt at primary school" and "I do not enjoy Maths" at -259*. That is, the more the Mathematics in secondary school is different from the Mathematics that is learnt at primary school, the lesser is the learners' enjoyment in Mathematics.

In light of the above findings, valuable information regarding the research question on the readiness of learners in Mathematics for the secondary phase reinforces the negative perceptions that they have in Mathematics. This concurs with the findings of Tilleczek (2007: 67) that learners are presented with many challenges at secondary school that may lead to achievement loss. This finding also links to Potari's (2014: 102) assertion that the transition period from primary to secondary school is characterized by the development of negative attitudes towards Mathematics.

5.11 Findings, interpretation and discussion of data from primary school learners

This section presents the results and discusses the findings obtained from the questionnaires in this study. The questionnaire was the primary tool that was used to collect data and was distributed to primary school learners. The data collected from the responses was analyzed with SPSS version 23.0. The results will present descriptive statistics in the form of graphs, cross tabulations and other figures for the qualitative data that was collected. Inferential techniques include the use of correlations and chi-square test values, which are interpreted using the p-values.

5.12 The sample

In total, 370 questionnaires were despatched to learners at 8 primary schools and 262 were returned, which gave a 71% response rate.

5.13 The research instrument

The research instrument comprised of 47 items, with a level of measurement at a nominal or an ordinal level. The questionnaire was divided into 4 sections, which measured various themes as illustrated below:

Section A - Biographical Information

Section B – Student Self and Task Related Beliefs in Maths

Section C – Learner Self-efficacy in Mathematics

Section D – My Mathematics Teacher

5.14 Reliability statistics

The two most important aspects of precision are reliability and validity. Reliability is computed by taking several measurements on the same subjects. A reliability coefficient of 0.70 or higher is considered as "acceptable". Table 5.16 reflects the Cronbach's alpha score for all the items that constituted the questionnaire.

Table 5.16: Cronbach's alpha

Section	Number of Items	Cronbach's Alpha
C – positive statements	8 of 8	0.756
C - negative statements	7 of 7	0.691
D – My Mathematics Teacher	12 of 12	0.753

The overall reliability score for each section exceeds the recommended Cronbach's alpha value of 0.800 for a newly constructed construct. This indicates a good degree of consistent scoring for the various sections of the research (Zinbarg 2009: 151). A commonly accepted rule for describing internal consistency using Cronbach's alpha is as follows, though a greater number of items in the test can artificially inflate the value of alpha and a sample with a narrow range can deflate it, so this rule should be used with caution. DeVellis (2012: 109) describes a commonly accepted rule of thumb for internal consistency is as follows:

Table 5.17 : Cronbach's alpha internal consistency

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

5.15 Factor Analysis

Why is factor analysis important?

Factor analysis is a statistical technique whose main goal is data reduction. A typical use of factor analysis is in survey research, where a researcher wishes to represent a number of questions with a small number of hypothetical factors. For example, as part of a national survey on political opinions, participants may answer three separate questions regarding environmental policy, reflecting issues at the local, state and national level. Each question, by itself, would be an inadequate measure of attitude towards environmental policy but, together, they may provide a better measure of the attitude. Factor analysis can be used to establish whether the three measures do, in fact, measure the same thing. If so, they can then be combined to create a new variable, factor score variable that contains a score for each respondent on the factor. The matrix table is preceded by a summarized table that reflects the results of KMO and Bartlett's Test. The requirement is that the Kaiser-Meyer-Olkin Measure of Sampling Adequacy should be greater than 0.50 and Bartlett's Test of Sphericity less than 0.05. In all instances the conditions are satisfied which allows for the factor analysis procedure.

Factor analysis is done only for the Likert scale items. Certain components divided into finer components. This is explained below in the rotated component matrix.

5.16 KMO and Bartlett's Test

Table 5.18: KMO and Bartlett's Test – Section C: positive statements

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.784
Bartlett's Test of Sphericity	Approx. Chi-Square	381.176
	df	28
	Sig.	.000

Table 5.19: KMO and Bartlett's Test – Section C: negative statements

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.788
Bartlett's Test of Sphericity	Approx. Chi-Square	250.669
	df	21
	Sig.	.000

All of the conditions are satisfied for factor analysis.

5.17 Rotated component matrix

Table 5.20: Rotated component matrix[a]

C - positive	Component	
	1	2
I am good at Maths	-.007	.744
Maths will help me in my career.	.729	-.005
I will use Maths in many ways as an adult.	.664	.276
Maths is important in everyday life.	.774	.065
I am confident of myself when I do Maths	.083	.733
My teacher makes me feel that Maths is useful in everyday life.	.435	.369
Overall I find the Maths lessons at school interesting.	.282	.671
My teacher thinks that I can do well in Maths.	.531	.559

Table 5.21: Rotated component matrix[a]

C - negative	Component	
	1	2
I do not enjoy Maths	.698	-.084
I find Maths too difficult for me	.652	-.036
Maths is dull and boring.	.663	.141
I rarely use the Maths I learn at school in everyday life	-.124	.881
Learning Maths is too stressful.	.745	.150
I would avoid studying Maths after matric	.453	.452
Maths is my worst subject	.592	.426

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Factor analysis is a statistical technique whose main goal is data reduction. A typical use of factor analysis is in survey research, where a researcher can represent a number of questions with a small number of hypothetical factors.

- ❖ The principal component analysis was used as the extraction method, and the rotation method was Varimax with Kaiser Normalization. This is an orthogonal rotation method that minimizes the number of variables that have high loadings on each factor. It simplifies the interpretation of the factors.
- ❖ Factor analysis/loading show inter-correlations between variables.
- ❖ Items of questions that loaded similarly imply measurement along a similar factor. An examination of the content of items loading at or above 0.5 (and using the higher or highest loading in instances where items cross-loaded at greater than this value) effectively measured along the various components.

5.18 Section A: Biographical Data

This section summarizes the biographical characteristics of the respondents. The table below describes the overall gender distribution by age.

Table 5.22: Gender distribution by age

			What is your gender?		Total
			Female	Male	
What is your age?	11	Count	1	1	2
		% within What is your age?	50.0%	50.0%	100.0%
		% within What is your gender?	0.9%	0.8%	0.8%
		% of Total	0.4%	0.4%	0.8%
	12	Count	68	57	125
		% within What is your age?	54.4%	45.6%	100.0%
		% within What is your gender?	60.7%	44.2%	51.9%
		% of Total	28.2%	23.7%	51.9%
	13	Count	37	59	96
		% within What is your age?	38.5%	61.5%	100.0%
		% within What is your gender?	33.0%	45.7%	39.8%
		% of Total	15.4%	24.5%	39.8%
	14	Count	4	8	12
		% within What is your age?	33.3%	66.7%	100.0%
		% within What is your gender?	3.6%	6.2%	5.0%
		% of Total	1.7%	3.3%	5.0%

	15	Count	1	3	4
		% within What is your age?	25.0%	75.0%	100.0%
		% within What is your gender?	0.9%	2.3%	1.7%
		% of Total	0.4%	1.2%	1.7%
	16	Count	0	1	1
		% within What is your age?	0.0%	100.0%	100.0%
		% within What is your gender?	0.0%	0.8%	0.4%
		% of Total	0.0%	0.4%	0.4%
	19	Count	1	0	1
		% within What is your age?	100.0%	0.0%	100.0%
		% within What is your gender?	0.9%	0.0%	0.4%
		% of Total	0.4%	0.0%	0.4%
Total		Count	112	129	241
		% within What is your age?	46.5%	53.5%	100.0%
		% within What is your gender?	100.0%	100.0%	100.0%
		% of Total	46.5%	53.5%	100.0%

According to Bertram (2004: 194), cross-tabulation is a way of understanding the relationships that exist between two or more variables. In this case, the relationship amongst gender and age is cross-tabulated with the various groups in Table 5.23. Overall, the ratio of males to females is approximately 1:1 (53.5%: 46.5%).
Within the age category of 13 years, 61.5% were male. Within the category of males only, 45.7% were within the age of 13 years. This category of males within the ages of 13 years formed 24.5% of the total sample.
Within the category of 15 years, 25% were females. Within the category of females, only 0,9% was within the age of 15 years formed 0.4% of the total sample. Within the category of total secondary school learners, 53.5% were male and 46.5% were females. Bertram (2004: 195) emphasizes that cross tabulations enable the researcher to examine relationships within the data that might not be readily apparent when analyzing total survey responses.

The average age and standard deviation in years is 12.6 ± 0.8.

Table 5.23: Average age and standard deviation

N	Mean	Std. Deviation	Minimum	Maximum
244	12.5943	.83354	11	19

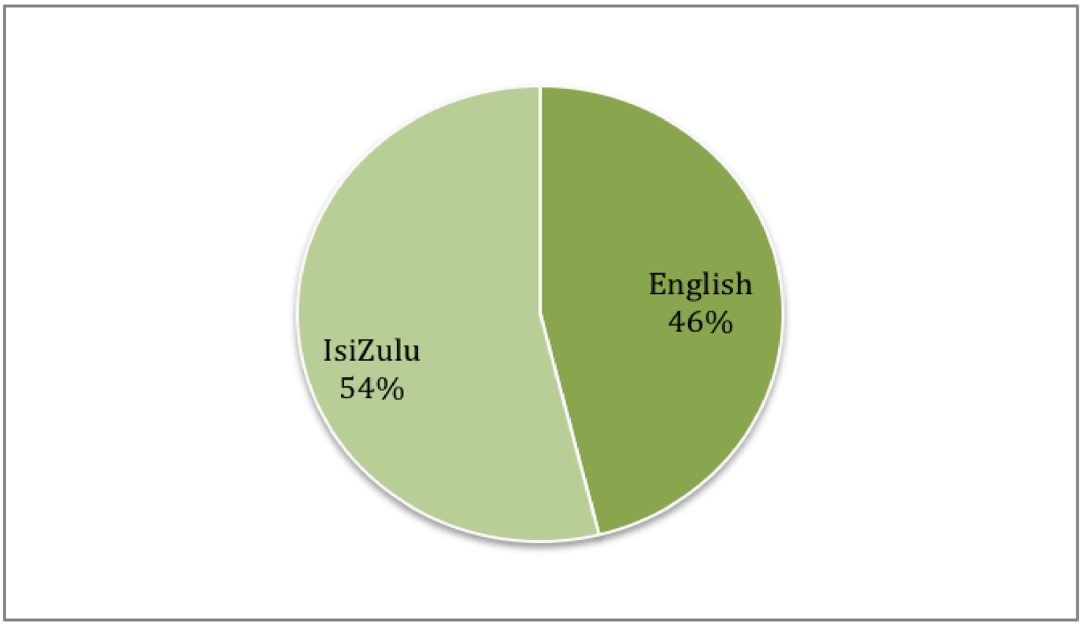
The table below indicates the home language of the learners.

Table 5.24: Home language of the learners

	Frequency	Percent
English	113	46.1
IsiZulu	132	53.9
Total	245	100.0

There was a split in terms of the home language between English and IsiZulu learners. Table 5.24 and Figure 5.12 describe the home language of learners; indicating 46.1% of the learners' home language is English and 53.9% are IsiZulu. The location of the schools also impacted on the racial denomination of the learners.

Figure 5.12: Home language of the learners



Since English is the language of instruction at schools, it may impact on Isizulu speaking learners.

The finding of Pennycuick (2013: 61) confirms that learners from differing home language may be disadvantaged and learners from low socio-economic levels may also endure disadvantages. This finding links to Engelmann *et al's*. (1991: 31) capacity for instruction as a theoretical framework that advocates that instruction is the same for all learners, and thus, each learner's response to the instruction will be differing. The concept of capacity for instruction as a theoretical framework constitutes bringing together learners to promote quality instruction and learning in Mathematics.

Figure 5.13: Primary school Mathematics

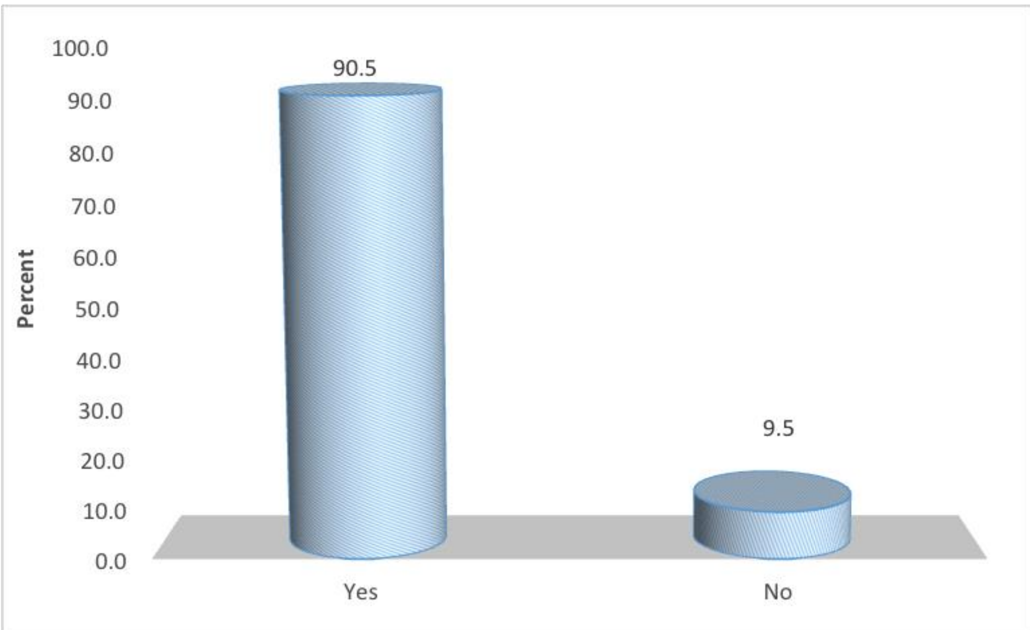


Figure 5.13 indicates learners liking of Mathematics at primary school level. An overwhelming response of 90.5% of learners agreed that they enjoyed Mathematics at primary school. In the light of the findings, if this type of enthusiasm continued in learners; it can be equated to Bandura's (1986: 5) theory of social learning which directly involves the way learners believe in themselves. This suggests that learners will be more likely to attempt, persevere and to be successful at tasks for which they have a sense of enjoyment or efficacy.

5.19 Section analysis

The section analyses the scoring patterns of the respondents per variable per section. Where applicable, levels of disagreement (negative statements) were collapsed to show a single category of "Disagree". A similar procedure was followed for the levels of agreement (positive statements). The results are first presented using summarized percentages for the variables that constitute each section. Results are then further analyzed according to the importance of the statements.

5.20 Section B - Student self and task-related beliefs in Mathematics

This section deals with student self and task related beliefs in Mathematics. The table indicates that the scoring patterns for the first four statements were significantly different. There were many more positive responses than negative ones. Furthermore, 48.3% of learners indicated that Mathematics was generally difficult for them. The last two statements did not show significantly different patterns.

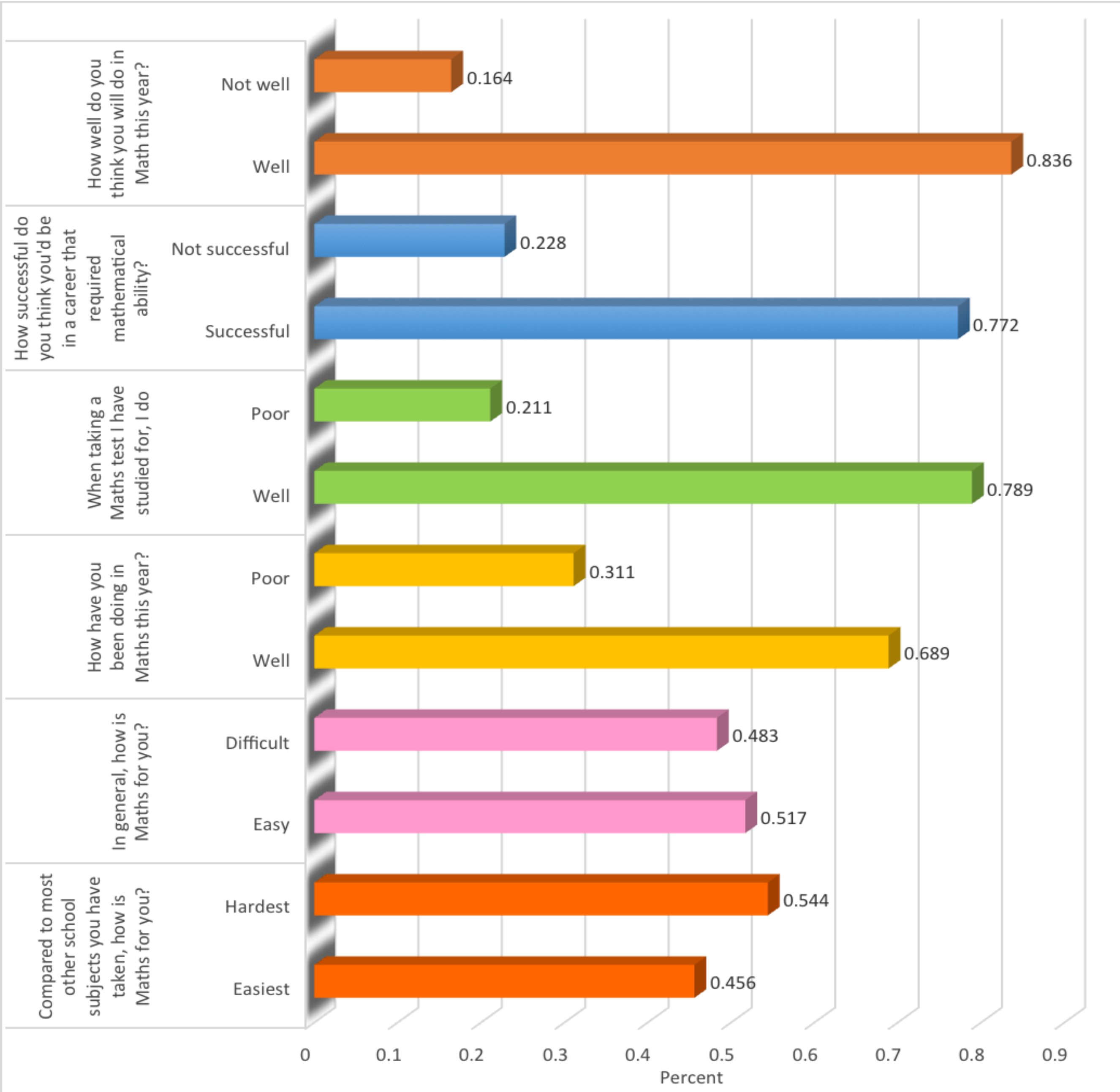
Table 5.25: Related Beliefs in Mathematics

		Count	Percent	chi-square p-value
How well do you think you will do in Math this year?	Not well	40	16.40%	0.000
	Well	204	83.60%	
How successful do you think you'd be in a career that required mathematical ability?	Not successful	54	22.80%	0.000
	Successful	183	77.20%	
When taking a Maths test I have studied for, I do	Poor	51	21.10%	0.000
	Well	191	78.90%	
How have you been doing in Maths this year?	Poor	76	31.10%	0.000
	Well	168	68.90%	
In general, how is Maths for you?	Difficult	117	48.30%	0.607
	Easy	125	51.70%	
Compared to most other school subjects you have taken, how is Maths for you?	Hardest	129	54.40%	0.173
	Easiest	108	45.60%	

A significant 83.60% of primary school learners indicated that they will do well in Mathematics and 77.20% also have confidence that they would be successful in a career that required mathematical ability. Once again the majority of the learners revealed positive attitudes towards Mathematics that is directly linked to Bandura's (1986) theory of self-efficacy. The theory of self-efficacy has a direct bearing on the positive relationship between mathematical achievement and positive attitudes found in learners.

Figure 5.14 indicates the learners' related beliefs in Mathematics on a horizontal bar graph. The figure respresents the first four positive scores from Table 5.26 above in the first four horizontal bars. The last two horizontal bars represent the last two statements, which are negative scores.

Figure 5.14: Beliefs in Mathematics



The majority of learners from grades 9 to 12 found Mathematics easy in primary school. This confirms that primary school learners are also finding the subject not

rigorous enough, which further concurs with findings by Ishikawa (1986: 7) that quality throughout the learners' school life is vital and he believed strongly in creating continuous quality improvement programs that should be constantly evaluated and changed. This would help to sustain learners' interest in Mathematics.
The following patterns are observed:

- The first four statements indicate higher positive scores than negative scores;
- The last two statements have similar responses,
- Learners were optimistic about their performance in Mathematics; and
- When they compared Mathematics to other school subjects they have taken, 54,4% stated that Mathematics was the most difficult subject.

To determine whether the scoring patterns per statement were significantly different per option, a chi square test was done. The null hypothesis claims that similar numbers of respondents scored across each option for each statement (one statement at a time).

Ninety-one point eight percent of learners in the primary school acknowledge that Mathematics is important in everyday life and 86% stated that they would use Mathematics in many ways in their everyday daily lives in the future. 47.5% are of the view that they will rarely use the Mathematics that they learn at school in everyday life. A small percentage of learners, ie. 27.7% found Mathematics to be difficult, majority of the learners; 83.7% stated that Mathematics lessons at school were interesting. A mere 13.9% claimed that Mathematics is their worst subject and 13.6% would avoid studying Mathematics after matric. Majority of the learners in the primary school, 73.4% stated that they enjoyed Mathematics. Thirteen point three percent also mentioned that they are not confident of themselves when they do Mathematics whilst 65.4% were confident.

5.21 Section C – Learner self-efficacy in Mathematics

These findings hinge on Bandura's (1986: 31) theory of self-efficacy, which is based on the positive relationship between mathematical achievement, and attitudes found in learners. This positive attitude should be maintained in learners for them to perform well at secondary school. The alternate hypothesis states that there is a significant difference between the levels of agreement and disagreement. The results are shown in Table 5.26.

Table 5.26: Learner self-efficacy in Mathematics

	Agree		Not Sure		Disagree	
	Count	Row N %	Count	Row N %	Count	Row N %
I am good at Maths	119	48.6%	100	40.8%	26	10.6%
I do not enjoy Maths	39	16.2%	25	10.4%	177	73.4%
Maths will help me in my career.	218	89.3%	19	7.8%	7	2.9%
I will use Maths in many ways as an adult.	209	86.0%	24	9.9%	10	4.1%
Maths is important in everyday life.	223	91.8%	15	6.2%	5	2.1%
I find Maths too difficult for me	67	27.7%	61	25.2%	114	47.1%
I am confident of myself when I do Maths	157	65.4%	51	21.3%	32	13.3%
Maths is dull and boring.	30	12.6%	17	7.1%	192	80.3%
My teacher makes me feel that Maths is useful in everyday life.	211	86.5%	12	4.9%	21	8.6%
I rarely use the Maths I learn at school in everyday life	115	47.5%	36	14.9%	91	37.6%
Overall I find the Maths lessons at school interesting.	200	83.7%	20	8.4%	19	7.9%
Learning Maths is too stressful.	71	29.6%	41	17.1%	128	53.3%
I would avoid studying Maths after matric	33	13.6%	47	19.3%	163	67.1%
My teacher thinks that I can do well in Maths.	193	79.1%	39	16.0%	12	4.9%
Maths is my worst subject	34	13.9%	14	5.7%	196	80.3%

Majority of the respondents, 91.8% acknowledged that Mathematics is important in everyday life and 86% stated that they would use Mathematics in many ways as an adult. In contrast, learners' views change in secondary school as illustrated in Table 5.13 on page 171). Eighty three point seven percent of the respondents agreed that 'Maths lessons at school are interesting.' The findings confirm that primary school learners in this study have more positive than negative attitudes towards Mathematics. This is also linked to Bandura's (1986: 31) theory that highlights performance outcomes as being most effective when compared to the other outcomes and such positive and negative experiences will influence the ability of learners.

Positive outcomes influence learners positively and vice versa. The highlighted sig. values (p-values) are less than 0.05 (the level of significance); which implies that the distributions were not similar. That is, the differences between the ways respondents scored were significant. The chi square test scores are shown below.

Table 5.27: Chi square test scores

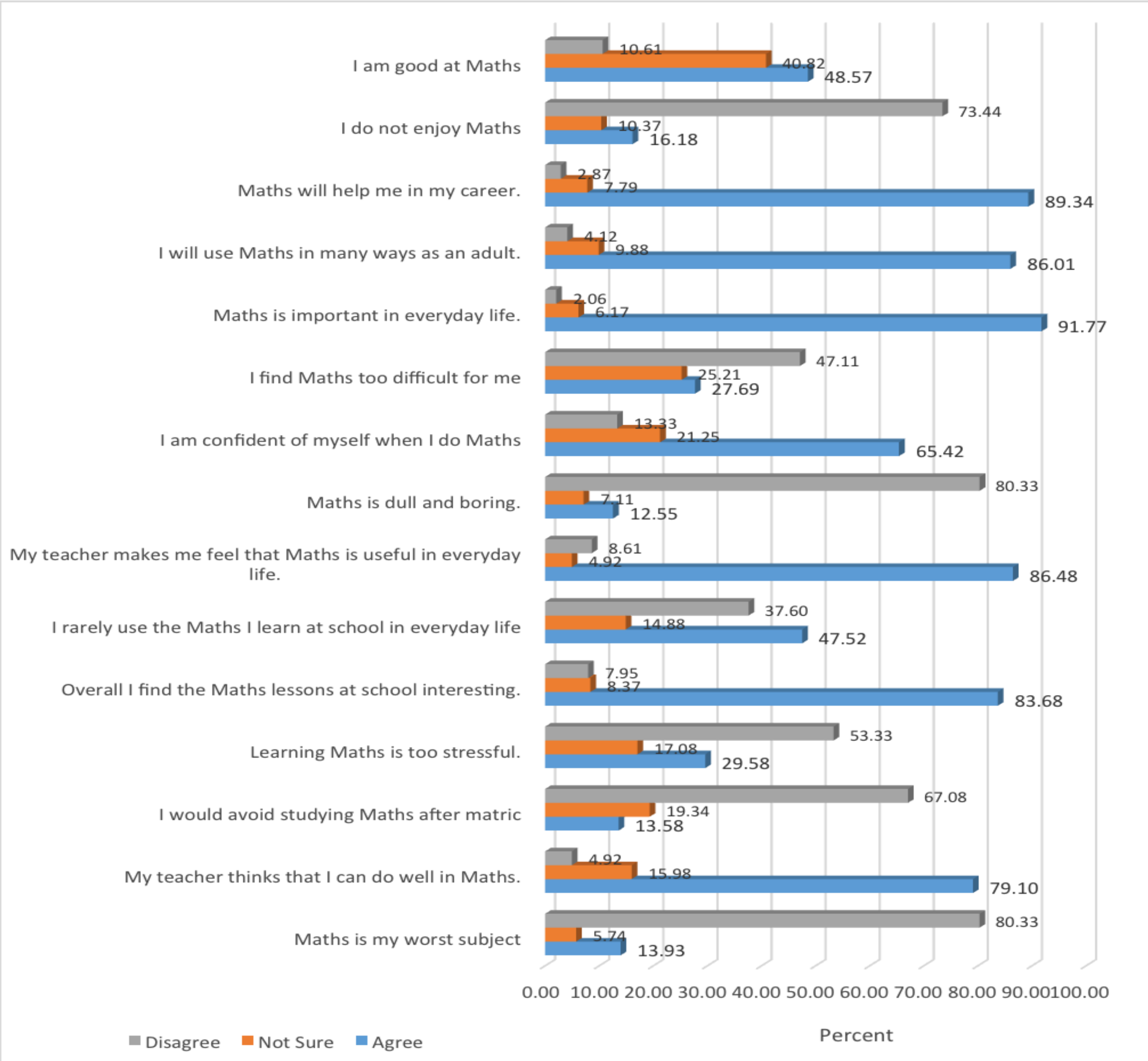
	Chi-Square	df	Asymp. Sig.
I am good at Maths	59.127	2	.000
I do not enjoy Maths	175.701	2	.000
Maths will help me in my career.	345.352	2	.000
I will use Maths in many ways as an adult.	304.617[d]	2	.000
Maths is important in everyday life.	374.025[d]	2	.000
I find Maths too difficult for me	20.884[e]	2	.000
I am confident of myself when I do Maths	113.425[f]	2	.000
Maths is dull and boring.	238.653[g]	2	.000
My teacher makes me feel that Maths is useful in everyday life.	310.582	2	.000
I rarely use the Maths I learn at school in everyday life	40.669[e]	2	.000
Overall I find the Maths lessons at school interesting.	272.644[g]	2	.000
Learning Maths is too stressful.	48.825[f]	2	.000
I would avoid studying Maths after matric	125.728[d]	2	.000
My teacher thinks that I can do well in Maths.	234.451	2	.000
Maths is my worst subject	244.951	2	.000

All of the p-values are less than 0.05. This implies that the scoring was significantly different per statement. The findings above further confirm quality gurus Deming *et als'*. (2014: 1004) findings on the process of root cause analysis that requires those with differing perspectives on the problem to work together to perform a better outcome. This collaboration is the starting point for establishing a support base for the solutions to problems that learners will later be developing.

Table 5.26 and Figure 5.15 details the various pertinent responses from primary school learners regarding their perspectives in Mathematics, namely: 80.33%

disagreed that Mathematics was their worst subject, whilst 13.93% agreed it was their worst subject and 5.74% were not sure.

Figure 5.15: Learner self-efficacy in Mathematics



A significant 80.33% of the respondents disagreed that Mathematics is dull and boring and 7.95% disagreed; whilst 67.08% disagreed that they would avoid studying Mathematics after matric and 13.58% agreed. A majority of the primary school learners stated that they would continue with Mathematics after completing Grade12; with 80.33% of the learners disagreeing that Mathematics was dull and boring.

A majority of learners, 73.44% disagreed that they do not enjoy Mathematics and 83.68% agreed that lessons at school were interesting; 91.77% agreed that Mathematics is important in everyday life and 65.42% agreed that they are confident of themselves when they do Mathematics. The findings and the transcript below illuminate and reinforce the idea that primary school learners have a high self-efficacy in Mathematics and all this is changed when they enter secondary school. It is interesting to note that three learners from secondary school stated the following during the interview:

"Maths became so difficult when I came to high school and I started to dislike the subject." Learner 1.

"My marks just dropped when I came to high school because the work just got tough and I used to get high marks in primary school." Learner 2.

"Maths was my best subject in primary school and now it is my worst…I think primary school work was very easy and I was an A student …. now in Grade 9… I just get a low pass mark in the thirties." Learner 3.

From the above transcript, it can be construed that learners cannot easily adjust to the level of the workload required in Mathematics at secondary school. This finding links up with the findings of Spaull and Kotze (2015: 13) that learners have acquired learning deficits early on in their schooling careers and such backlogs are the root cause of under-performance in later years.

The findings indicate that primary school learners generally have a high self-efficacy in Mathematics. This finding links with Pajares and Schunk's (2001: 8) finding that learners who belong to a class with relatively high self-efficacy may reap a vicarious benefit and be successful in Mathematics. Learners need to believe not only in their capability to carry out academic tasks but also in their capability to implement adaptive learning strategies. Nearly 94% of the learners indicated that they understood English which is the medium of instruction at their schools and a further 85.7% indicated that they understood the concepts taught in Mathematics at primary school. Only 14.3% of learners indicated that they do not understand the concepts and terminology in Mathematics. The researcher verified from the primary school learners' questionnaires; that all 14.3% of the learners' home language is IsiZulu. The other IsiZulu speaking learners understood English. A cross tabulation of the variables indicate that the learners self-efficacy was high and consistent in the primary school.

Table 5.28 is a cross tabulation of the variables therein.

Table 5.28: Cross tabulation of the variables

	Do you understand the language well enough in Mathematics?		Total
	Yes	No	
% within Do you understand the concepts/ terminologies in Maths ?	96.0%	4.0%	100.0%
% within Do you understand the language well enough in Maths?	87.8%	54.5%	85.7%
% of Total	82.3%	3.4%	85.7%
% within Do you understand the concepts/ terminologies in Maths?	80.0%	20.0%	100.0%
% within Do you understand the language well enough in Maths?	12.2%	45.5%	14.3%
% of Total	11.4%	2.9%	14.3%
% within Do you understand the concepts/ terminologies in Maths?	93.7%	6.3%	100.0%
% within Do you understand the language well enough in Maths?	100.0%	100.0%	100.0%
% Total	93.7%	6.3%	100.0%

5.22 Section D – My Maths teacher

This section is an evaluation of the Mathematics teacher by the learners. The blue lines in Figure 5.16 indicate levels of agreement and the orange represent disagreement. It is noted that the scoring levels are similar for expectations and perceptions. However the experience levels for D4 and D5 are lower than the rest.

Generally, learners' percentage of experiences in primary school is close to the percentage of their expectations. A large majority of learners experiences of 88.1% of the learners found their Mathematics teacher to be polite, courteous and kind whilst 98% have expectations that of their teacher to be knowledgeable and confident in Mathematics; and 86.5% experience this.

Figure 5.16: My Maths Teacher

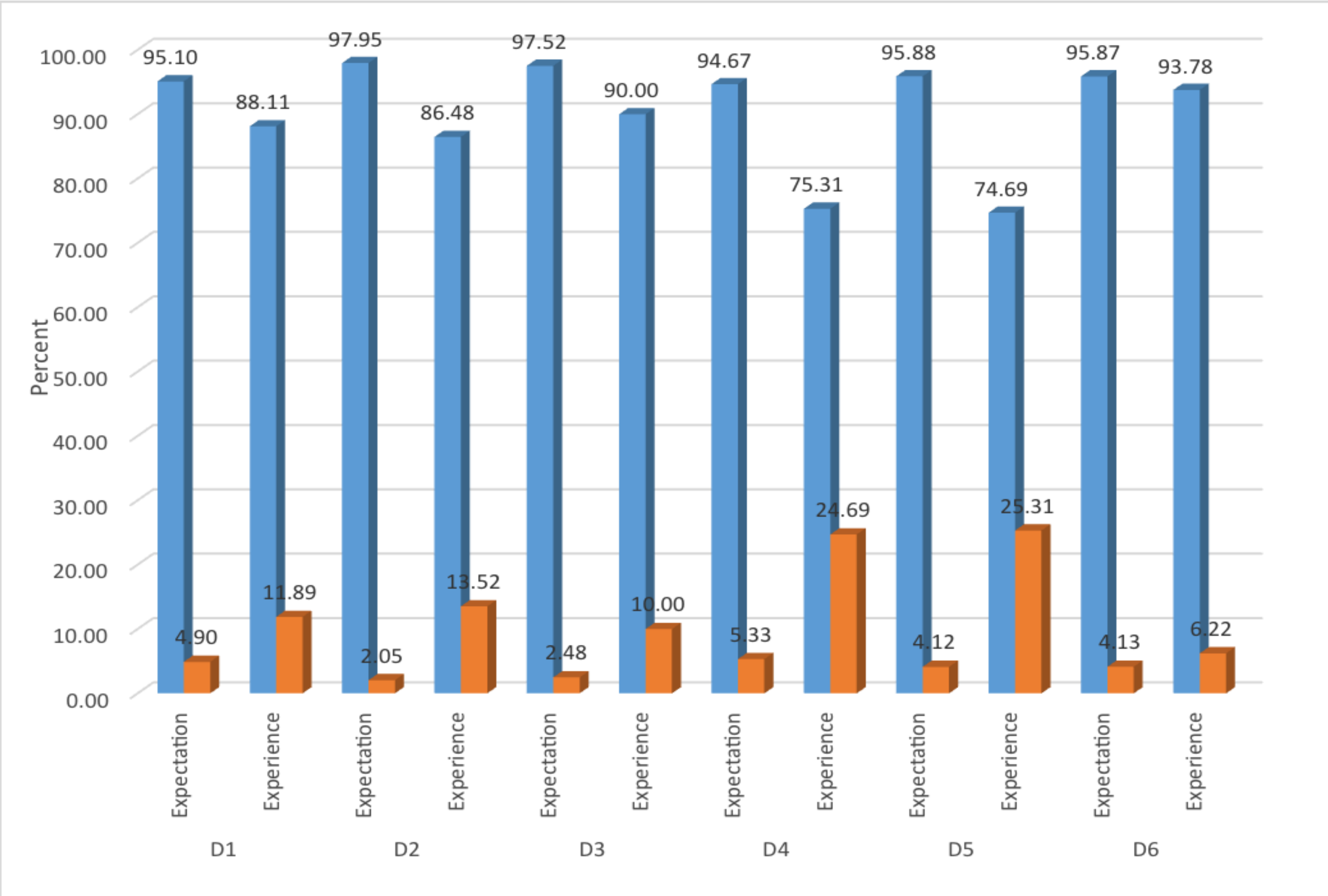


Table 5.29: Evaluation of the Mathematics teacher by learners

			% Agree	% Disagree
D1	My Maths teacher is polite, courteous and kind	Expectation	95.1%	4.9%
		Experience	88.1%	11.9%
D2	My Maths teacher is knowledgeable and confident in Maths	Expectation	98.0%	2.0%
		Experience	86.5%	13.5%
D3	My Maths teacher is helpful when I ask for help	Expectation	97.5%	2.5%
		Experience	90.0%	10.0%
D4	My Maths teacher is enthusiastic and encourages us in class	Expectation	94.7%	5.3%
		Experience	75.3%	24.7%
D5	My Maths teacher explains the lessons and I understand	Expectation	95.9%	4.1%
		Experience	74.7%	25.3%
D6	My test papers are marked timeously and my teacher reviews the test	Expectation	95.9%	4.1%
		Experience	93.8%	6.2%

This also provides a possible answer to the critical question, namely whether learners' perceptions, expectations and experiences of Mathematics at primary school level prepared them for secondary school Mathematics. Most learners had positive experiences, expectations and experiences in primary school.

The Wilcoxon test was used to determine if the difference between the expectations and experience were significantly different. The results are shown below.

Table 5.30: Wilcoxon test results

	D1	D2	D3	D4	D5	D6
Z	-2.874[b]	-4.542[b]	-3.530[b]	-6.018[b]	-6.755[b]	-1.291[b]
Asymp. Sig. (2-tailed)	.004	.000	.000	.000	.000	.197

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Even though the scoring patterns are similar, in all instances the expectation values are higher than what they actually experience. The differences between these are significant for all but the last pair (D6) "My test papers are marked timeously and my teacher reviews the test" which has a slight discrepancy.

5.23 Hypothesis testing

The traditional approach to reporting a result requires a statement of statistical significance. A **p-value** is generated from a **test statistic.** A significant result is indicated with "$p < 0.05$". These values are highlighted with a *. A second Chi-square test was performed to determine whether there was a statistically significant relationship between the variables (rows vs columns). The null hypothesis states that there is no association between the two. The alternate hypothesis indicates that there is an association.

The table summarizes the results of the chi-square tests (see Excel spreadsheet – Hypothesis Testing). For example: The p-value between "How well do you think you will do in Math this year?" and "Did you enjoy Maths?" is .0000. This means that there is a significant relationship between the variables highlighted in yellow. That is, the level of enjoyment does influence how well learners believe they will do in Maths. “I am good at Maths” and “I am confident of myself when I do Maths” is .0000. The levels of being positive also influence the way learners think of themselves in Mathematics. “Maths will help me in my career” and “I will use Maths in many ways as an adult” also shows a significant relationship between the variables where learners believe that Maths would benefit them in the future. All values without an * (or p-values more than 0.05) do not have a significant relationship.

5.24 Correlations

Bivariate correlation was also performed on the (ordinal) data. The results are found in the appendix (see Excel spreadsheet: correlations table in the appendices).

The results indicate the following patterns.

Positive values indicate a directly proportional relationship between the variables. A negative value indicates an inverse relationship. All significant relationships are indicated by a * or **.

For example, the correlation value between “When taking a Maths test I have studied for, I do well” and “How have you been doing in Maths this year?” is 0.303*. This is a directly related proportionality. Learners indicate that the more they study for Maths, the better they will do, and vice versa.

Another correlation value between “Maths will help me in my career. ” and “I am good at Maths is 0.132*. This is also directly related proportionality. Learners indicate that the more they realise that they are good at Maths, the more determined they are in Mathematics, and vice versa.

The next correlation value between “Maths is important in everyday life.” and “I will use Maths in many ways as an adult is 0.399*. This is also directly related proportionality. Learners indicate that the more they realise that Mathematics is important in everyday life, they are more likely to use Maths in many ways as an adult. Thus, they develop positive attitudes in Mathematics, and vice versa.

Another correlation value between “Maths is dull and boring” and “I find Maths too difficult for me” is 0.342*. This is also directly related proportionality. Learners indicate that the more they realise that Maths is dull and boring, the more they find Mathematics too difficult, and vice versa.

Negative values imply an inverse relationship. That is, the variables have an opposite effect on each other. That is, as one increases, the other decreases.

For example, the correlation value between “I am good at Maths” and “Maths is dull and boring.” is -0.274**. That is, the better a learner does in Maths, the less dull and boring he will find it.

The correlation value between “I am good at Maths” and “I find Maths too difficult for me.” is -466**.The better a learner does in Maths, the less difficult he or she will find it.

Another correlation value between “I am confident of myself when I do Maths” and “Maths is my worst subject.” is -.250**. That is, the more confidence a learner has in Mathematics, it is no more the worst subject he or she find.

The correlation value between “Overall I find the Maths lessons at school interesting.” and “Maths is my worst subject.” is -.250**. That is, the more interesting Mathematics lessons are, the fear of Mathematics being the worst subject decreases.

The correlation value between “My teacher makes me feel that Maths is useful in everyday life,” and “I find Maths too difficult for me is -.211**. That is, the more the teacher makes the learner feel that Mathematics is useful in everyday life, the less difficult he or she will find it.

The findings of such negative attitudes in learners regarding Mathematics are also a plausible explanation for the poor results in ANA, NSC and TIMSS in Mathematics. This is further confirmed by Reddy’s (2006: 3) findings that learners have difficulty grasping key Mathematical concepts and 90% do not possess basic Mathematical knowledge. This further impacts on the findings by Livingstone’s (1999: 9) human capital theory is that learners’ learning capacities can be compared to the resources of a country and when the resources are effectively exploited the results are profitable for the growth of the economy and the opposite occurs for negative attitudes.

5.25 Primary School Teachers’ Output

5.25.1 Teacher Analysis

This section summarizes the scoring patterns observed by the primary school teacher respondents.

5.25.2 Section A: Biographical Data

All of the respondents were permanent employees.

Table 5.31: Biographical Data

	Frequency	Percent
Permanent	18	100.0

There were 50% males and 50% females in the sample.

Table 5.32: Number of respondents

	Frequency	Percent
Female	9	50.0
Male	9	50.0
Total	18	100.0

The above table illustrates that the ratio of male to female respondents was equal. This illustrates that 50% of the total respondents were male and that 50% of the respondents were female. This gender profile from this study is in keeping with the national government's policy on gender parity within the workplace. Table 5.33 indicates the grades that the respondents are currently teaching Mathematics to.

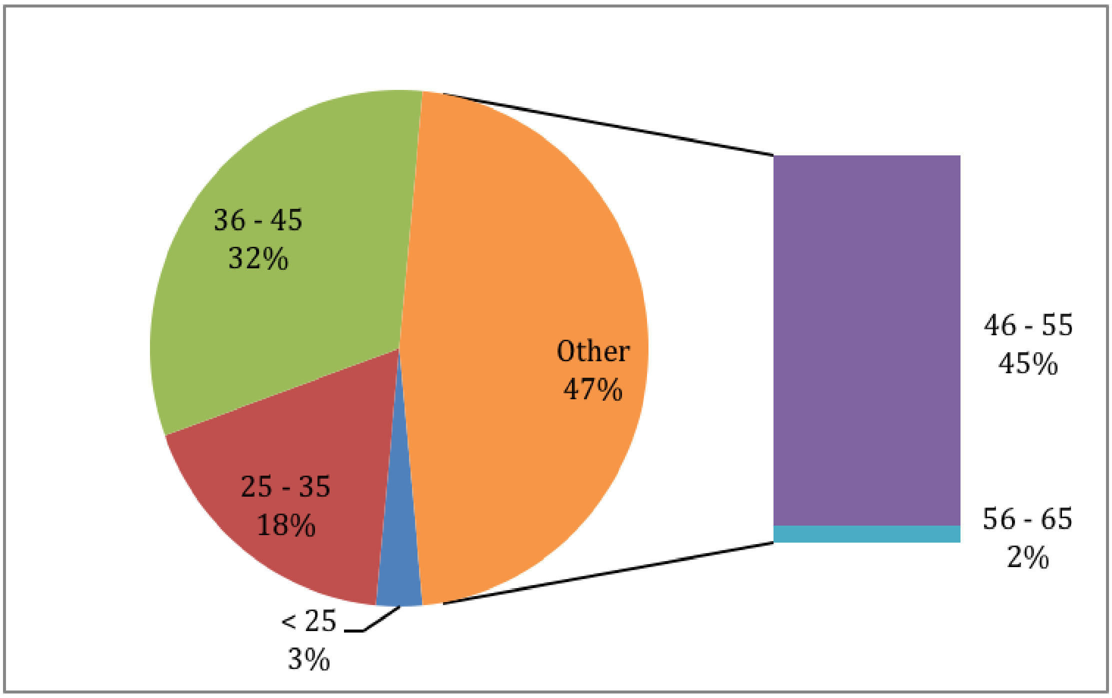
Table 5.33: Grades the respondents are teaching Mathematics

	Table %
Grade 4	50.0%
Grade 5	50.0%
Grade 6	50.0%
Grade 7	33.3%

5.25.3 Age distribution of respondents

Below is a diagrammatic representation of the age distribution of respondents. This was done so that age can be correlated with experience.

Figure 5.17: Age distribution

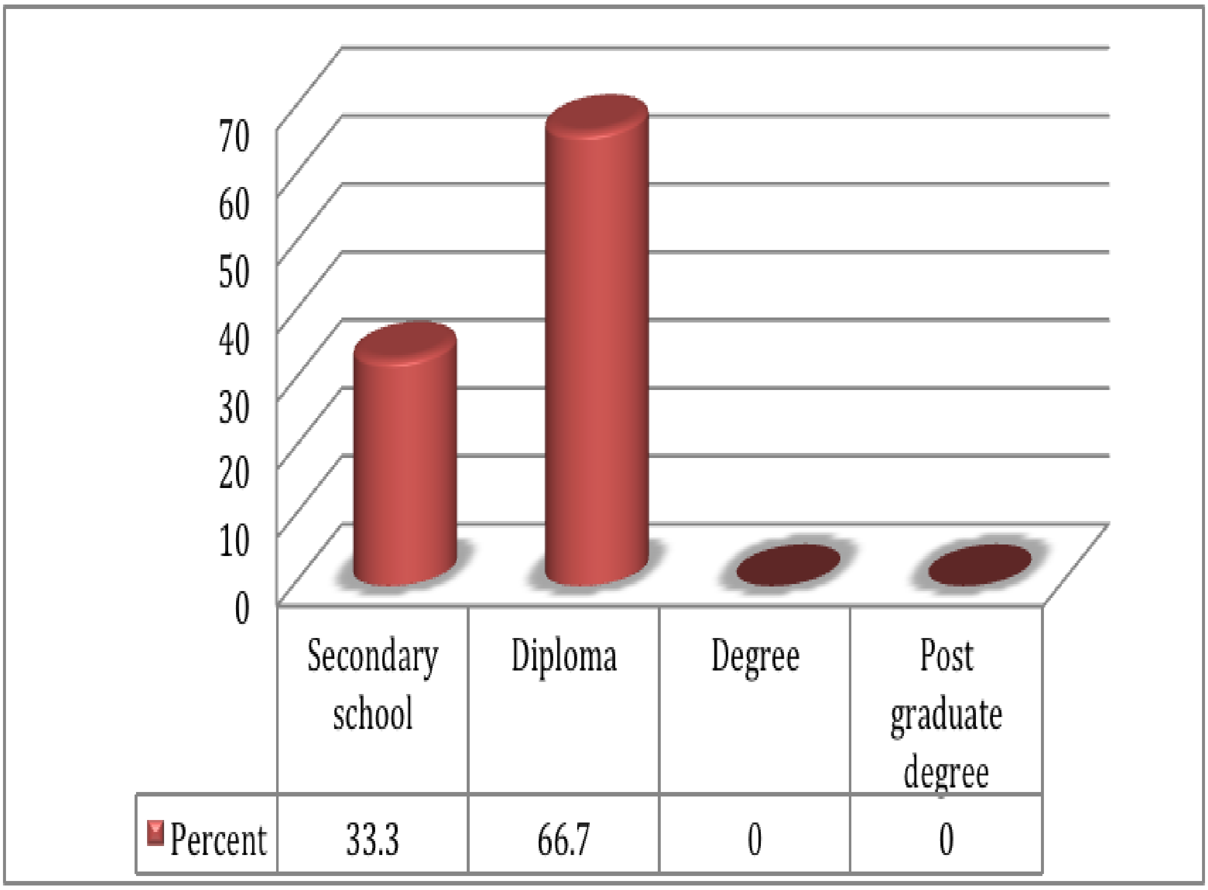


The pie chart in Figure 5.17 indicates that the majority of respondents (45%) were between the ages of 46 and 55 years. In total, 77% of the respondents were between the ages of 36 and 55 years. Only 3% of the respondents were younger than 25 years. It is therefore evident that the majority of the respondents are between the ages of 36 to 55 years. This reveals that the majority of primary school Mathematics educators from this sample are fairly mature and were born and educated during the apartheid era. Age as a factor is in keeping with the South African government's vision for the public service, which to a large extent considers age as an important determinant in ensuring efficient and effective service delivery (Forbes and Lynn 2005: 571).

5.25.4 Qualifications distribution of respondents

Figure 5.18 indicates the highest qualification in Mathematics of the respondents. The cylindrical bar graph in Figure 5.18 indicates that all the respondents had a teaching qualification, namely that 66.7% percent of the primary school Mathematics educators have studied towards a diploma in the field of Mathematics.

Figure 5.18: Respondents highest qualification in Mathematics



Although all teachers were qualified, it is noted that 33.3% of the teachers' highest qualification in Mathematics is secondary school education. It also indicates that the KwaZulu-Natal Department of Education employs educators who are qualified in the schools that formed the study in Mafukezela Gandhi District. However, 33.3% do not have a tertiary Mathematics qualification and yet they teach Mathematics at primary schools. No Mathematics teachers have a degree or postgraduate degree in Mathematics where they could have obtained more in-depth specialization in Mathematics. This relates with Bernstein's (2010: 25) finding that primary school teachers of Mathematics are not specialists in the subject.

5.25.5 Section B: SERVQUAL

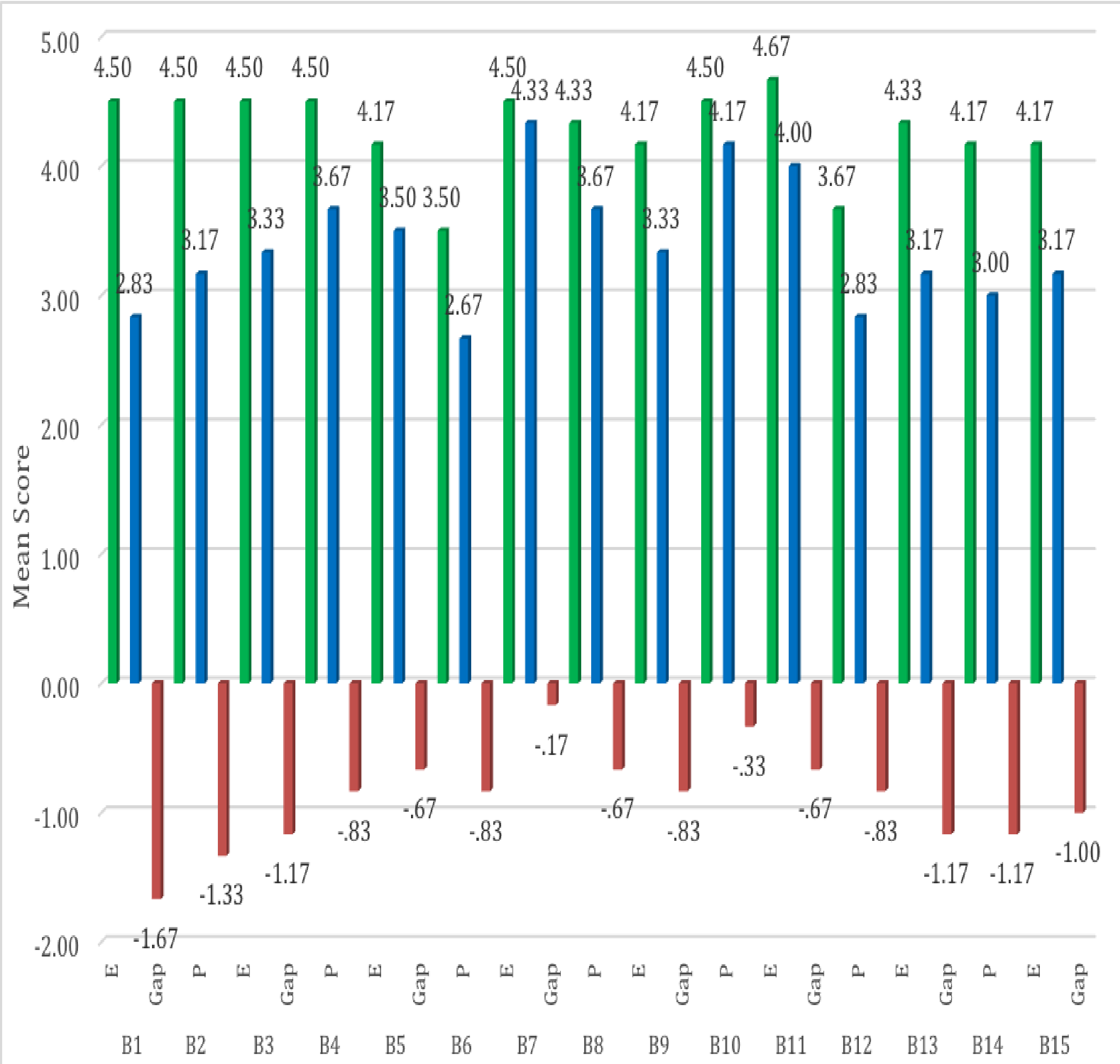
This section consists of 15 questions based on an amended SERVQUAL instrument and relates to support in terms of expectations and perceptions of service received.

Table 5.34 : SERVQUAL instrument expectations and perceptions

The Maths department at the DoE is committed to good service	B1	E	4.50
		P	2.83
		Gap	-1.67
I receive adequate support from the Maths Department at DoE to perform my tasks efficiently and effectively	B2	E	4.50
		P	3.17
		Gap	-1.33
The Maths department’s employees are enthusiastic when providing the required Maths service	B3	E	4.50
		P	3.33
		Gap	-1.17
The Maths department’s employees provide the required Maths service in a professional manner.	B4	E	4.50
		P	3.67
		Gap	-.83
The Maths department’s employees respond to e- mails/ telephone calls timeously	B5	E	4.17
		P	3.50
		Gap	-.67
The Maths department’s employees are able to resolve Maths issues timeously	B6	E	3.50
		P	2.67
		Gap	-.83
The Maths department’s employees are always presentable and well-mannered when providing the required Maths service	B7	E	4.50
		P	4.33
		Gap	-.17
The Maths department’s employees are suitably qualified in their area of expertise which enables them to deliver quality Maths support.	B8	E	4.33
		P	3.67
		Gap	-.67
The Maths department’s employees provide significant professional development workshops to develop Maths teachers?	B9	E	4.17
		P	3.33
		Gap	-.83
The Maths department’s employees are polite, courteous and helpful.	B10	E	4.50
		P	4.17
		Gap	-.33
The Maths department’s employees are very knowledgeable and confident regarding their respective areas in Maths	B11	E	4.67
		P	4.00
		Gap	-.67
The Maths department’s employees are able to resolve Maths issues timeously	B12	E	3.67
		P	2.83
		Gap	-.83
The location of DoE Maths offices are easily accessible	B13	E	4.33
		P	3.17
		Gap	-1.17
The Maths department’s employees have up to date resources which are easily obtainable	B14	E	4.17
		P	3.00
		Gap	-1.17
There are significant professional development workshops to develop Maths teachers	B15	E	4.17
		P	3.17
		Gap	-1.00

(Parasuraman *et al.* 1985: 44). This is expected as one anticipates the best possible service. Parasuraman, Zeithaml, and Berry (1994: 113) developed “The Gap Analysis Model”, which is a model of service quality and it shows an integrated view of the expectation and perception relationship. The graphical representation of the gap scores follows. The expectation (E) values are in green, the perception (P) values are in blue and the gap scores are in red. The perception scores are all lower. The difference between perception and expectation (P – E) yields the gap score. A gap score between -1 and -2 is considered very significant. A gap score between 0 and -1 indicates that teachers' perceptions and expectations are met.

Figure 5.19: Expectations and perceptions with gap scores



According to Parasuraman *et al.* (1985: 43) the term "expectations" is used in service quality literature and expectations are viewed as desires or wants made by the consumer about what they feel a service provider should offer rather than would offer. The term “perceptions” unambiguously support the notion that service quality, as perceived by consumers, stems from what they feel service firm should offer i.e. from their expectations and perceived service quality is therefore viewed as the degree and direction of discrepancy between consumers perceptions and expectations (Parasuraman *et al.* 1985: 44). This is expected as one anticipates the best possible service. Parasuraman, Zeithaml, and Berry (1994: 113) developed “The Gap Analysis Model”, which is a model of service quality and it shows an integrated view of the expectation and perception relationship. The graphical representation of the gap scores follows. The expectation (E) values are in green, the perception (P) values are in blue and the gap scores are in red. The perception scores are all lower. The difference between perception and expectation (P – E) yields the gap score. A gap score between -1 and -2 is considered very significant. A gap score between 0 and -1 indicates that teachers’ perceptions and expectations are met. The ‘Maths Department at DoE’ refers to the various authorities from the Department of Education that are involved in Mathematics in the different phases at schools.

The following statements are significant because these statements are below teachers’ expectations:

A gap score for “The Maths department at the DoE is committed to good service” is -1.67, which indicates that teachers’ perceptions are that they do not receive adequate service from various role players at the DoE such as subject advisors in Mathematics and curriculum planners etc.

A gap score for “I receive adequate support from the Maths Department at DoE to perform my tasks efficiently and effectively” is -1.33. This indicates that teachers expect to receive adequate support in terms of teaching from the DoE and that their perception does not match their expectation.

The gap score for teachers’ expectation regarding “The Maths department’s employees have up to date resources which are easily obtainable” is -1.17. Once again, this does not meet their perceptions because teachers do not have easy access to updated resources.

Another gap score for “The location of DoE Maths offices are easily accessible” is -1.17. This does not meet their expectation.

The gap score for teachers expectation on “There are significant professional development workshops to develop Maths teachers” is -1.00. This does not match their perception because there are insufficient professional development workshops to develop Maths teachers to implement CAPS in teaching Mathematics. Teachers also iterated during the interview that,

“We just have one workshop per year which is just for a few hours……we are involved in group activities and presentation…….not much of a professional development.”

These findings tie up with Jansen’s (2015: 7) findings that ongoing professional development intervention would help to improve the knowledge of Mathematics teachers.

A significant 90% of the respondents were convinced that the Mathematics CAPS policy document for primary phases adequately addresses the values as enshrined in the Constitution of the Republic of South Africa (1996). Over 80% of educators agreed that the government had to change the national curriculum after 1994. This indicates that educators were optimistic and enthusiastic to embrace changes in the new curriculum, with 78% mentioning that the content and assessment aspects of CAPS were more progressive than the old apartheid curriculum. The majority of respondents stated that there was a lack of consultation amongst the various stakeholders regarding the implementation of South Africa’s national curriculum in Mathematics. Eighty-five percent of respondents stated that they were positive about the CAPS Mathematics curriculum. A further 90% of respondents noted that the CAPS syllabi in Mathematics in the primary phase were repetitive from Grades 4 to 6. It was evident in the interview that there was no consultation before the CAPS document in Mathematics was drawn up. A lack of consultation among the various stakeholders regarding the transformation of South Africa’s national curriculum has a negative impact. The fact is that from 100% of the respondents who were interviewed, 83.3% indicated that:

“There was no consultation or discussion at the grassroots level regarding the CAPS policy document… and we are just expected to follow like sheep.” Lack of consultation may have negative implications for curriculum transformation, more so when respondents are required to implement a curriculum which they were not part

of from the outset. Since respondents were not consulted about the new curriculum, they felt coerced and uneasy with the implementation of the CAPS policy. It was evident that respondents should have been consulted and involved in the curriculum development process from its inception until implementation. Engaging with teachers involved in teaching Mathematics would have had positive spin offs for curriculum policy development and implementation to enhance quality teaching and learning.

The tension during development workshop of policy surfaces and teachers respond with criticism about the poor scheduling of the development workshop sessions. Teachers contend that sometimes the poor timing of the mediation session imposes on their curriculum implementation time and places them under undue pressure to meet a multitude of closely spaced deadlines, as is evident below:

"What's irritating is the lack of consultation with us over the training date and time… they expect us to leave classes and attend workshops where we hardly learn anything new."

A comparison was made between the foundation and the primary phase, as is seen in the excerpt below:

"*It's a difficult, lengthy syllabus….there are fewer subjects in the foundation phase... too much content in primary school and too little time."*

This particular construction of policy illuminates that the difficult, lengthy curriculum serves as a barrier and control mechanism for access to a smooth transition from the foundation to intermediate phase. The construction of policy reveals an emerging hindrance.

Table 5.35: Wilcoxon Signed Rank Test

	B1P - B1E	B2P - B2E	B3P - B3E	B4P - B4E	B5P - B5E	B6P - B6E	B7P - B7E	B8P - B8E	B9P - B9E	B10P - B10E	B11P - B11E	B12P - B12E	B13P - B13E	B14P - B14E	B15P - B15E
Z	-1.826[b]	-1.841[b]	-1.841[b]	-1.890[b]	-1.342[b]	-1.342[b]	-1.000[b]	-1.342[b]	-1.342[b]	-1.414[b]	-1.342[b]	-1.342[b]	-1.342[b]	-1.342[b]	-1.342[b]
Asymp. Sig. (2-tailed)	.068	.066	.066	.059	.180	.180	.317	.180	.180	.157	.180	.180	.180	.180	.180

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks

The Wilcoxon p-values indicate that the observed differences are significant. The test statistic for the Wilcoxon Signed Rank Test is W, defined as the smaller of W+ (sum of the positive ranks) where the null hypothesis is true, therefore the research hypothesis is true.

5.25.6 Section C – about your learners

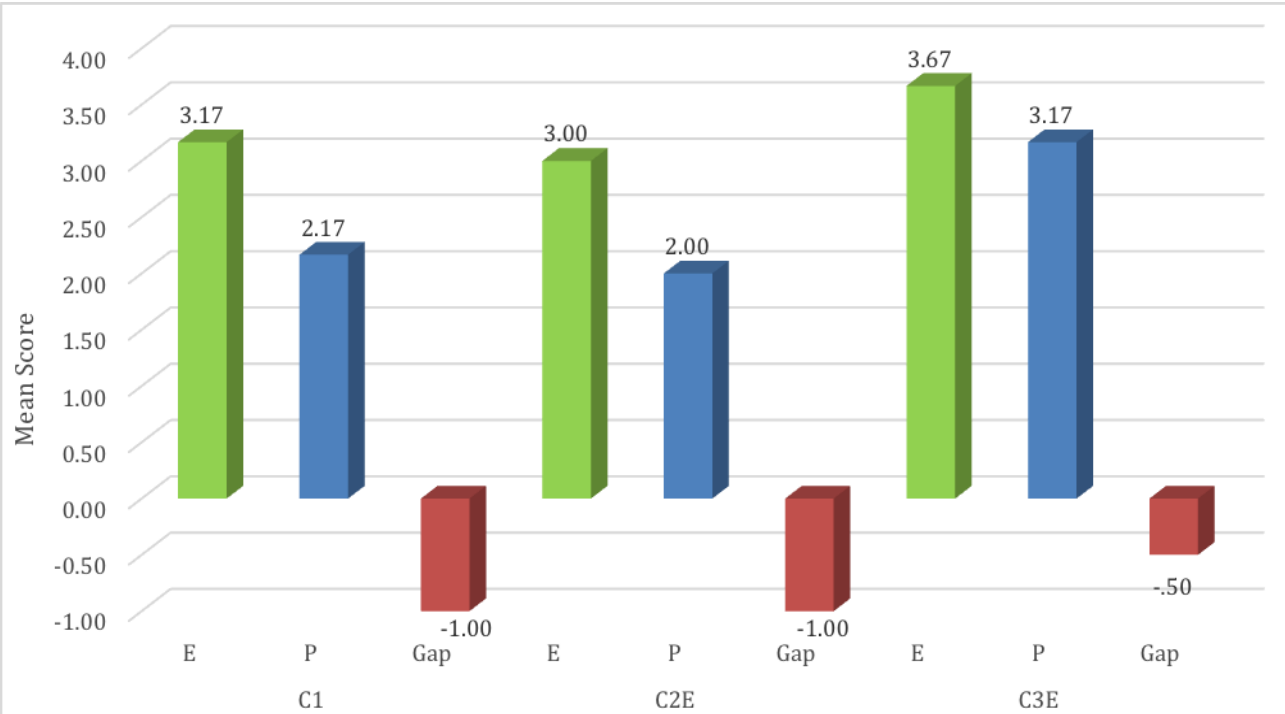
This section consists of 8 questions based on your learners.

Table 5.36: Teachers' expectations and perceptions of learners

C1 The learners who come from foundation phase are adequately prepared for primary school Maths			**C2E** Learners perform better in algebra and substantially worse in geometry			**C3E** Learners grasp concepts taught in Maths easily		
E	P	Gap	E	P	Gap	E	P	Gap
3.17	2.17	-1.00	3.00	2.00	-1.00	3.67	3.17	-.50

It is evident that teachers' expectations do not match their perceptions with regards to their learners in Mathematics.

Figure 5.20: Teachers' gap score of learners



The observed gaps mean that teachers' expectations do not meet their perceptions in terms of their learners. The gap score for, teachers' expectation regarding "The learners who come from foundation phase are adequately prepared for primary school Maths" is -1.00.

The gap score for teachers' expectation of "Learners perform better in algebra and substantially worse in geometry" is -1. This means that learners' performance in terms of algebra and geometry is not as expected; it is worse in both aspects of Mathematics.

Another gap score for "Learners grasp concepts taught in Maths easily" is -50. This indicates that teachers expect learners to grasp concepts taught in Maths easily but this is not so. This finding provides a possible answer to the critical question about the readiness of learners in Mathematics for secondary phase. This further is confirmed by Reddy *et al's.* (2015: 23) finding that learners lack the pre-requisite knowledge from the lower grades and thus lack of basic knowledge impacts on learner achievement by limiting academic performance in Mathematics.

This is also seen with the p-values in Table 5.37 below.

Table 5.37: Test Statistics[a]

	C1P - C1E	C2P - C2E	C3P - C3E
Z	-1.414[b]	-1.342[b]	-1.342[b]
Asymp. Sig. (2-tailed)	.157	.180	.180

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks

The Wilcoxon p-values indicate that the observed differences are significant. The test statistic for the Wilcoxon Signed Rank Test is W, defined as the smaller of W+ (sum of the positive ranks) where the null hypothesis is true, therefore the research hypothesis is true.

5.26 Secondary school teacher analysis

This section summarizes the responses of the participants' who teach Mathematics at secondary schools.

5.26.1 Section A: Biographical data

Table 5.38 indicates the capacity in which Mathematics teachers' are appointed at schools.

Table 5.38: Teacher Appointment

	Frequency	Percent
Permanent	24	80.0
Temporary (UTE)	6	20.0
Total	30	100.0

Eighty percent of the respondents were permanent employees appointed by the DoE .

Table 5.39: Gender of teachers

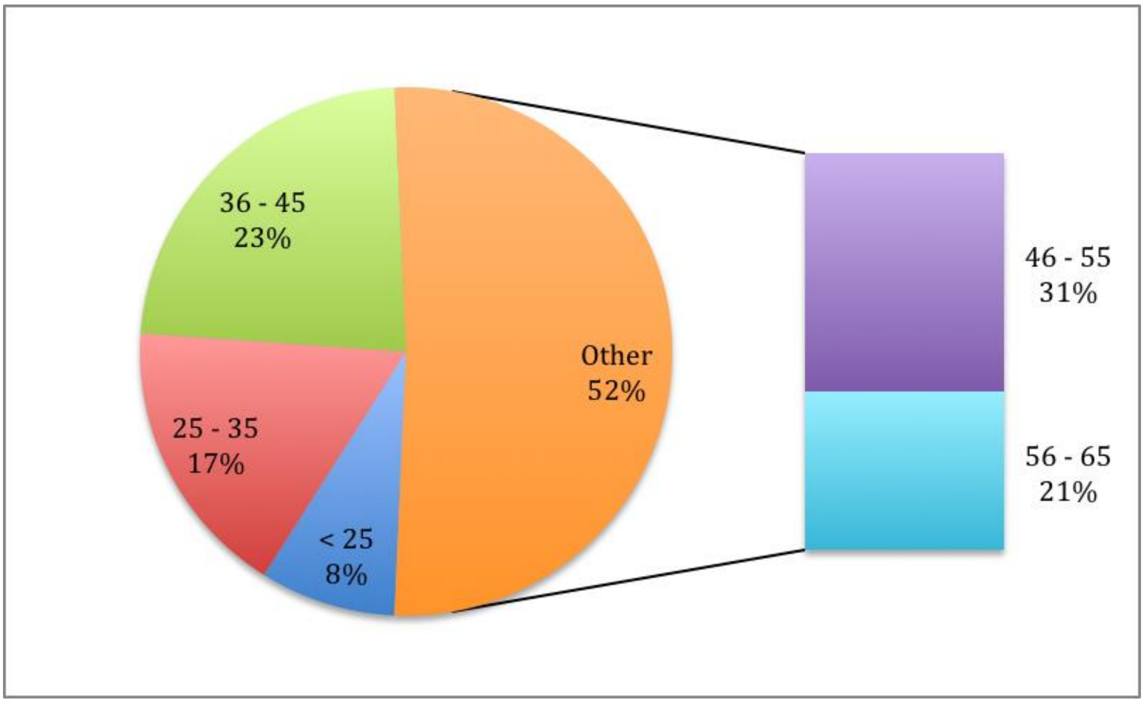
	Frequency	Percent
Female	24	80.0
Male	6	20.0
Total30	30	100.0

Table 5.39 illustrates that the ratio of male to female respondents was 1:4. This illustrates that 20% of the total respondents were male and that 80% of the respondents were female. There are more female respondents teaching Mathematics than male respondents in this sample.

5.26.2 Age distribution of respondents

Figure 5.21 is a representation of the age distribution of respondents. This was done so that age can be correlated with experience.

Figure 5.21: Age distribution of respondents



The pie chart in Figure 5.21 indicates that majority of the respondents (52%) were between the ages of 46 and 65 years. Only 8.3% of the respondents were younger than 25 years. Majority of the respondents from this sample are between the ages of 36 to 65 years.

Table 5.40: Teaching loads

	Percent
Grade 8	60.0
Grade 9	40.0
Grade 10	40.0
Grade 11	40.0
Grade 12	20.0

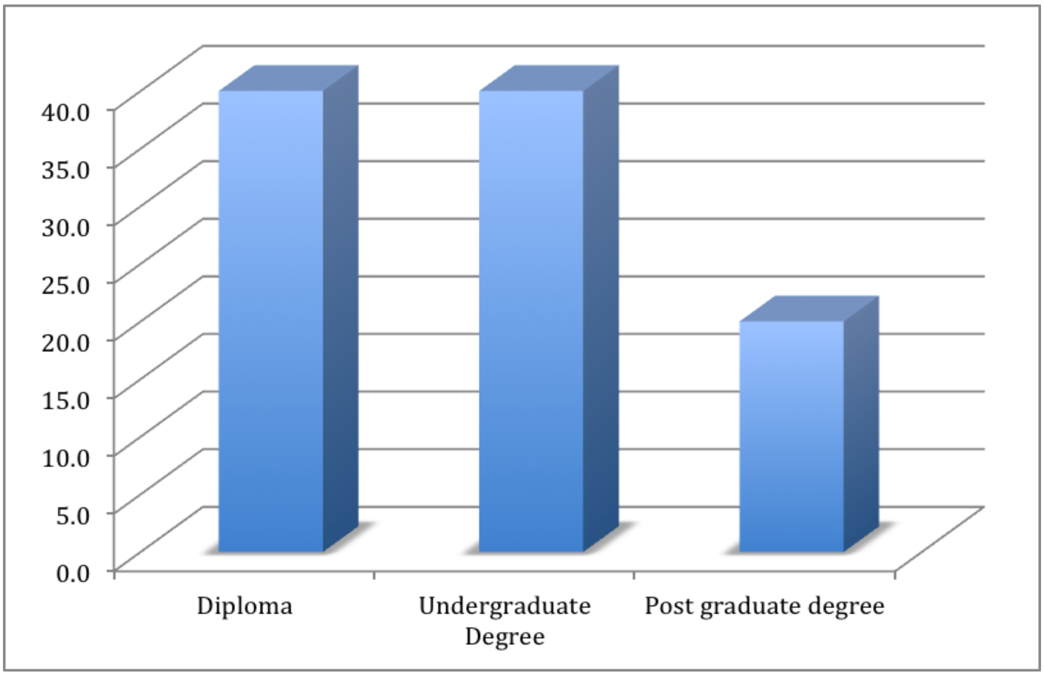
Only 20% of the respondents were involved in teaching at Grade 12 level. The rest of the educators taught from Grades 8 to 11.

5.26.3 Highest qualification in Mathematics

Figure 5.22 indicates that all of the respondents had a teaching qualification. The highest qualification of the respondents was as follows: 40% attained a diploma; 20%

were undergraduates and 20% had a post graduate degree. From this sample of statistics all of the respondents had a tertiary qualification and hence was qualified to teach in the secondary phase. None of the Mathematics educators who participated in the study was in possession of a Masters or Doctorate degree. The finding from this sample could relate to Bernstein's (2010: 35) view that South Africa and society needs to change its views and attribute greater status to teachers to make teaching a more attractive profession with better incentives for good performance.

Figure 5.22: Respondents highest qualification in Mathematics



Bernstein's (2010: 41) critical finding is that teaching is not respected enough and teachers who perform well and aspire to further their qualification are not rewarded nor recognized. This finding is significant in the sense that it relates to the respondents in this study. A significant majority (80%) of teachers' highest qualification in this sample is in possession of a diploma or an undergraduate teaching degree.

5.26.4 Section B: SERVQUAL - This section consists of 15 questions based on an amended SERVQUAL instrument. It describes support in terms of expectations and perceptions of service received.

Table 5.41: SERVQUAL questionnaire

The Maths department at the DoE is committed to good service	B1	E	4.40
		P	2.20
		Gap	-2.20
I receive adequate support from the Maths Department at DoE to perform my tasks efficiently and effectively	B2	E	4.80
		P	1.60
		Gap	-3.20
The Maths department’s employees are enthusiastic when providing the required Maths service	B3	E	4.40
		P	2.40
		Gap	-2.00
The Maths department’s employees provide the required Maths service in a professional manner.	B4	E	4.60
		P	2.80
		Gap	-1.80
The Maths department’s employees respond to e- mails/ telephone calls timeously	B5	E	4.20
		P	2.40
		Gap	-1.80
The Maths department’s employees have up to date resources which are easily obtainable	B6	E	4.60
		P	1.80
		Gap	-2.80
The Maths department’s employees are always presentable and well-mannered when providing the required Maths service	B7	E	4.60
		P	3.40
		Gap	-1.20
The Maths department’s employees are suitably qualified in their area of expertise that enables them to deliver quality Maths support.	B8	E	5.00
		P	2.00
		Gap	-2.40
The Maths department’s employees provide significant professional development workshops to develop Maths teachers?	B9	E	5.00
		P	1.80
		Gap	-3.20
The Maths department’s employees are polite, courteous and helpful.	B10	E	4.80
		P	3.20
		Gap	-1.60
The Maths department’s employees are very knowledgeable and confident regarding their respective areas in Maths	B11	E	4.80
		P	2.20
		Gap	-2.60
Learners expect me to be confident and knowledgeable in Maths	B12	E	4.60
		P	3.60
		Gap	-1.00
My learners trust that they will always receive support in Maths	B13	E	4.80
		P	4.60
		Gap	-0.20
My learners expect me to be courteous and polite irrespective of the circumstances	B14	E	4.80
		P	4.20
		Gap	-0.60
My learners expect me to show empathy and reassurance when they experience problems in Maths	B15	E	4.80
		P	4.40
		Gap	-0.40
I have a friendly disposition with the learners	B16	E	4.80
		P	4.40
		Gap	-0.40
My learners are happy with my teaching.	B17	E	4.20
		P	3.80
		Gap	-0.40
My learners expect me to have their best interest at heart.	B18	E	4.80
		P	4.40
		Gap	-0.40

Table 5.41 indicates many differences that are between -1 and -4. That means that the differences are every significant. Difference in the measurement between the expectations and perceptions mean that a gap has been detected and, therefore, a certain system's modification is necessary to develop service quality. Each statement discusses certain discrepancy in the system that may affect the quality of service offered as illustrated in Table 5.41.

The graphical representation of the gap scores follows. The Expectation (E) values are in green, the Perception (P) values are in blue and the Gap scores are in orange. The perception scores are all lower. The difference between Perception and Expectation (P – E) yields the Gap score. A Gap score between -1 and -4 is considered very significant. The following statements are significant because these statements are below teachers' expectations:

The gap score for "The Maths department at the DoE is committed to good service" is -2.20, which indicates that teachers' perceptions are that they do not receive the adequate service they expect.

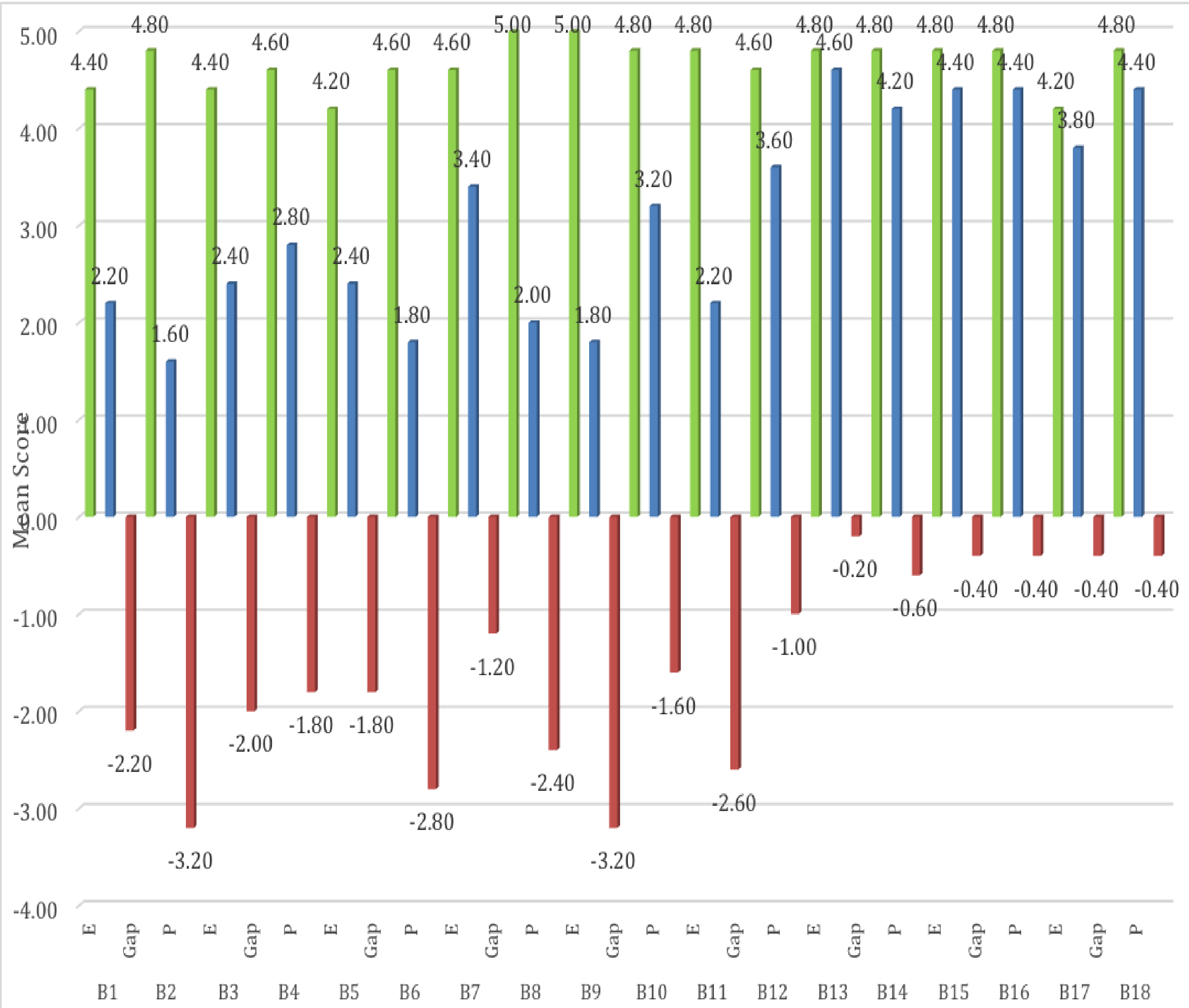
The gap score for teachers' expectation regarding "The Maths department's employees have up to date resources which are easily obtainable" is -2.80. Once again, this does not meet their perception because teachers do not have easy access to updated resources.

Another gap score for "I receive adequate support from the Maths Department at DoE to perform my tasks efficiently and effectively" is -3.20, which means that teachers do not receive adequate support from the Maths Department at DoE to perform their tasks efficiently and effectively.

Another gap score for "I receive adequate support from the Maths Department at DoE to perform my tasks efficiently and effectively" is -3.20, which means that teachers do not receive adequate support from the Maths Department at DoE to perform their tasks efficiently and effectively.

The statements are illustrated in Figure 5.23 regarding support from the Mathematics department in the DoE.

Figure 5.23: Support from Mathematics department



The statement "The Maths department's employees are enthusiastic when providing required Maths service" has a gap score of -2.00. Teachers' expectations are not met. Teachers' expectations in "The Maths department's employees are suitably qualified in their area of expertise which enables them to deliver quality Maths support" also has a gap score of -2.40. Again, their expectations are not met in terms of the services received.

The gap score for “The Maths department’s employees respond to e- mails/ telephone calls timeously” is -1.80. Teachers do not experience timeous responses from the Mathematics department employees.

A gap score for “The Maths department’s employees have up to date resources which are easily obtainable” is -2.80, which indicates that teachers’ perceptions are that they do not receive adequate up to date resources.

The gap score for “The Maths department’s employees are suitably qualified in their area of expertise which enables them to deliver quality Maths support” is -2.40, which means that teachers do not receive the quality of Maths support services as expected.

Another closely related statement, “The Maths department’s employees are very knowledgeable and confident regarding their respective areas in Maths” has a gap score of -2.60, which indicates that teachers interactions with department employees do not meet their expectations of them being very knowledgeable and confident regarding Maths.

The statement with the largest gap score of -3.60 is: “The Maths department’s employees provide significant professional development workshops to develop Maths teachers”, which means that teachers expect to receive significant professional development workshops to develop them in Mathematics but this service does not take place as expected.

All the respondents who were interviewed (100%) stated that there were few workshops for the year and a total of 25% of respondents stated that the secondary phase Mathematics training workshops were not effective.

“*The facilitator is either not a Mathematics specialist nor knowledgeable in conducting the workshop to assist teachers.”*

Another contributing factor to this discontentment could be the lack of monitoring tools to evaluate curriculum delivery amongst educators within schools. Owing to this problem, some educators do not comply with the policies related to the implementation of CAPS. Both the primary and secondary school teachers mentioned that there was a lack of teaching aids and resources. However, 84% of the respondents pointed out that they received some resources at the FET Mathematics training workshops.

If respondents did not attend the training workshops, they would be disadvantaged. This would have a negative impact on educators who are under-performing in the class and learners become demotivated with school and education. Jansen's (2006: 6) finding is conclusive that "When you give a child poor education and there is nothing going on to change that, they simply succumb and drop out". A majority of respondents stated that: *"Workshops should be on-going basis and feedback needs to be implemented so that problems could be obviated in the course of the year."*
It may be concluded from the above responses that Mathematics training was not entirely effective, therefore educators were not adequately trained by the FET and GET Curriculum unit. Respondents showed a level of disagreement,
"*So far we have encountered a few problems in implementing the CAPS curriculum*."
This reveals that respondents did experience challenges while implementing the CAPS Mathematics curriculum, which was largely due to educators initially receiving only one day of training in CAPS. They were subsequently expected to implement the new curriculum. Arguably, there was insufficient training and support of Mathematics educators by the KwaZulu-Natal Department of Education's Curriculum Unit regarding the implementation of CAPS. Singh-Pillay and Alant (2015: 18) concurred that the construction of policy as a hindrance annuls the policy and leads to subversion of policy in respect of assessment and curricula content.

Respondents indicated that the syllabus is too vast and learners' attitudes towards Mathematics also makes it difficult for quality teaching and learning to take place. Sixty percent of the teachers concern was also a lack of parental support.
"Majority of parents are not interested in monitoring their children's progress."
This is further confirmed by Putnam's (2015: 21) finding that parental involvement is very important in their children's education. Many teachers articulated that
"There is a lack of consultation between primary and secondary school educators.. no consolidation and continuation."

Sixty-three point three percent of the respondents stated that learners have difficulty in understanding the lessons and concepts; and 72% of teachers commented that reading and comprehending concepts in Mathematics was becoming a serious problem. Two teachers commented the following:

"*Learners who are not ready to progress and those who could not read are beating the system because the requirements for promotion of learners at schools are changing to cater for the weak learners…. the requirement for learners in FET to pass is very low".* Teacher 1.

"Some learners cannot read and they are sitting in secondary school….I don't know how they passed primary school?" Teacher 2.

A majority of the respondents stated that

"*The learners who come from primary school are not adequately prepared for secondary school Maths… we have to teach basics all over again*".

Some were also concerned about the qualifications of teachers who teach Mathematics in primary school:

"*There are no specialist Maths educators… primary school principals allow non-specialists to teach Maths from Grades 4 to 7… when these learners enter secondary school they cannot cope with the syllabus…. a stronger foundation is required at primary school level."*

The above finding ties up with Slavin *et al's*. (2009: 853) finding that in order to ensure that learners have positive experiences with Mathematics education, they need to get it from teachers that are qualified to provide quality education. Their finding also reveals that primary schools should have specialist Mathematics teachers because learners' foundation in Mathematics is very important as stated:

"Background knowledge in certain sections is limited or poor and concepts have to be re-taught…. new topics are foreign and they cannot link primary school Maths to secondary school…they rely too much on the calculator."

Seventy-two percent of the respondents were convinced that the Mathematics CAPS policy document for primary and secondary phases adequately addresses the values as enshrined in the Constitution of the Republic of South Africa (1996). Over 80% of the educators agreed that the government had to change the national curriculum after

1994. This indicates that educators were optimistic to embrace changes in the new curriculum. Sixty-seven percent mentioned that the content and assessment aspects of CAPS were more progressive than the old apartheid curriculum and 62% of respondents stated that they were positive about the CAPS Mathematics curriculum.
A further 90% of the respondents noted that:
"The CAPS syllabi in Mathematics in the senior and FET phases were rather demanding and learners who come into secondary phase from primary school have difficulty in adjusting to a demanding curriculum."
Respondents also mentioned during the interview that they experienced that the monitoring and evaluation of the implementation of CAPS was taking place effectively at school. Whilst other respondents verified that CAPS was not being monitored and evaluated by their immediate supervisors.
Respondents also stated that
"Poor managers are appointed at many schools and promotions are not based on merit….nobody bothers about qualification nor years of experience…instead promotions are a fiasco."
Inadvertently poor leadership at schools hinders the implementation of policies. Taylor (2010: 7) emphasizes that the schooling system is beset with many problems, including poor management and leadership and poor school leadership is failing South African pupils. Weak and ineffective school management leads to the non-delivery of CAPS and policies that eventually contribute to the high failure rate and dysfunctionality of the education system. This ties up with Bernstein's (2010: 23) finding that there is nothing worse than a hard working teacher operating in trying circumstances in a badly managed school where nothing happens to those that shirk their responsibilities.

5.27 Secondary school teachers' open-ended questions

The attainment of good NSC examination results creates tension and uncertainty at the DoE node in respect of teachers' pedagogical practice and identity. In the construction of teachers' pedagogical practice and identity, the Mathematics and Mathematical Literacy subject advisors use good exam (NSC) results to confer qualities, visions and motivations onto teachers. This arbitrary association between good NSC exam results and best practice highlights the tension and contradiction during implementation of policy, as is evident below:

"It's demeaning and embarrassing for us when the number of failures are mentioned at meetings....I am teaching at a disadvantaged school....You don't know how hard it is to work in such trying conditions I face!" "*We function in different working environments, our learners are different, their socio-economic problems are unique so how can they compare our result to advantaged schools in urban areas?"*

Good NSC exam results demonstrate how these get enlisted during implementation of policy to verify a particular vision for policy implementation. Singh-Pillay (2010: 134) states that alliances are also formed with teachers and good NSC exam results in the construction of their pedagogical identity to motivate them to produce good NSC exam results.

The shortened timeframe between the formulation and implementation process of a new policy such as CAPS and its goal of involving all stakeholders in its formulation is used to invalidate the policy, as stated by another respondent:

"CAPS policy was implemented before schools and teachers were properly trained."

"Good exam results will dispel fears and concerns of the public about implementation; it will stop criticism and good matric results will show that the CAPS curriculum was successfully implemented."

Singh-Pillay (2010: 133) articulates that associations are tenuous and in a perpetual state of becoming renewed due to the mobilization, translation or dislocation they encounter within the network of policy construction and SKAV development. Good NSC exam results serves as a measuring tool to validate the implementation of policy as successful and the success of teachers' pedagogical practice as well as to alleviate the fears of stakeholders in secondary school. It was evident in the interview that there was no consultation before the CAPS document in Mathematics was drawn up. A lack of consultation amongst the various stakeholders regarding the transformation of South Africa's national curriculum has a negative impact. Ninety percent of the respondents indicated that there was no consultation or discussion at grassroots level regarding CAPS. Since respondents were not consulted about the new curriculum, they felt compelled and uneasy with the implementation of the CAPS policy. A majority of respondents stated the following:

"We are burdened with tasks….overloaded with duties at school…..facilitators and

teachers interpret the curriculum differently….learners' failure rate in Maths is increasing." "Policy documents that should be designed in a user-friendly manner, which teachers can refer to with ease so that effective teaching can take place."
These may have negative implications for curriculum transformation, more so when respondents are required to implement a curriculum which they were not part of from the outset. It was evident that respondents should have been consulted and involved in the curriculum development process from its inception until implementation. Engaging with teachers involved in teaching Mathematics would have positive spin offs for curriculum development and implementation to enhance quality teaching and learning. It is evident that the implementation of CAPS policy is performed in a hierarchal "top down" approach. The practice of implementation of CAPS policy illustrates how teachers are thrust into a situation during policy transformation. This situation exposes the micro politics of policy reform. Subject advisors and school managers resort to using power to seek the obedience of teachers during the implementation of policy. Thus, teachers have no option but to comply with protocol and the power differentiation. Therefore, the practice of implementation of CAPS policy becomes mandatory as a "top down" approach. The association formed by the subject advisor and the SMT who represents the DoE emerges in a conflicting nature on the process of mediation and implementation of policies.

This situation is also reflective of the type of associations that are formed and reveals that such important policies are cascaded in unstable sets of relations which lead to policies being jeopardized. The findings reflect Vygotsky's (1981: 39) Activity Theory that helps to understand and analyze the relationship between the human mind (what people think and feel) and activity (what people do). This theory indicates the interconnections that stabilize the network. This means that alliance formation involves negotiations and compromise between actors about the goals to be attained. The alliances formed expose the contradictions and tension within the network. It is these alliances that indicate where the gaps are in this network; which associations are failing the dissemination of the network; and which need to be strengthened and cause variations in the translations in the network. The evolving alliances formed reveal that actors are in unstable relations. The analysis reveals that tensions, contradictions and uncertainties result in the destabilization of policy. This is crucial because students, teachers and many other stakeholders in education need more powerful theoretical tools for helping them decide what is important in classrooms of various kinds and when.

A majority of respondents articulated their concern on the large number of learners failing Mathematics as a result of the construction of policy as being encumbered. This particular construction and implementation of policy alerts one to the decreasing number of learners pursuing Mathematics in the FET phase as stated by a respondent: *"I'm aware that the number of learners studying Mathematics is decreasing, but our poor matric pass rate in Maths will definitely not attract more learners to choose pure Maths as well." "Many learners are opting to choose Maths Lit ….the number of failures in Maths Lit is also on the increase."*

The dwindling number of learners in Mathematics epitomizes the tension, conflict and contradictions between policy mediation and policy goals. The alliances formed with good NSC exam results lead to the affirmation of policy and policy goals. Good NSC exam results serve as a motivation to prevent the exodus of learners from Mathematics to Mathematical Literacy. Mwingirwa (2015: 193) confirms that transition between academic levels is a potential threat to learners' academic progress and if such a transition is not well-managed, it can lead to consequences such as loss in performance, disengagement, disinterest and negative attitudes towards key subjects such as Mathematics.

According to Maylor (1996: 3), project management includes planning, organizing, directing and controlling activities. Conducting content and assessment workshops, especially on the new content focus areas, can be regarded as a project that needs careful planning, implementation and evaluation and moves through the following three phases (Van der Waldt and Knipe, 1998: 58) to develop teachers:

Preparation phase: During this phase the needs of the project are determined; a problem analysis is conducted; a plan for the project is formulated; the project is designed and finally a budget is allocated for the project.

Implementation phase: Ensures that the organizational arrangements are made; manage the process by means of financial control mechanisms and decision-making;

perform project activities; monitor the project; and obtain feedback.

Evaluation phase: Ensure that the project is evaluated against a set of quantifiable criteria as outlined in the original plan; determine whether objectives of the project were achieved and ascertain the quality of the process. Good practice should be identified and possibly shared with other subjects in the FET band (Du Toit 2002: 234-235). The adoption of the above strategy will ensure that the new content in CAPS Mathematics curriculum is effectively cascaded to all educators.

Table 5.42 : Wilcoxon test score

Test Statistics[a]

	- B1E	- B2E	- B3E	- B4E	- B5E	- B6E	- B7E	- B8E	- B9E	B10E	B11E	B12E	B13E	B14E	B15E	B16E	B17E	B18E
Z	-1.890[b]	-2.041[b]	-1.890[b]	-1.841[b]	-1.732[b]	-1.890[b]	-1.857[b]	-1.841[b]	-2.041[b]	-2.070[b]	-2.070[b]	-1.633[b]	-1.000[b]	-1.732[b]	-1.414[b]	-1.414[b]	-1.414[b]	-1.414[b]
Asymp. Sig.	.059	.041	.059	.066	.083	.059	.063	.066	.041	.038	.038	.102	.317	.083	.157	.157	.157	.157

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

5.28 The Wilcoxon test score

The Wilcoxon test scores are shown in Table 5.42. The Wilcoxon p-values indicate that the observed differences are significant. The test statistic for the Wilcoxon Signed Rank Test is W, defined as the smaller of W+ (sum of the positive ranks) where the null hypothesis is true. Therefore the research hypothesis is true.

5.29 Primary school teachers' open-ended questions

Table 5.43 indicates the scoring patterns and open-ended responses to each of the questions in section C.

Table 5.43: Common responses

C1 Are there significant professional development workshops to train Maths teachers?	Percent
Yes	16.7
No	83.3
Total	100.0

C1 Comment	Percent
Only one for the year; facilitator is not a Maths specialist	16.7
One workshop held to implement CAPS	16.7
Workshops should be on-going and feedback needs to be implemented	66.6
Total	100.0

C2 In your opinion are the learners who come from primary school adequately prepared for secondary school Maths?	Percent
Yes	33.3
No	66.7
Total	100.0

C2 Comment	Percent
Basics have to be taught again	16.7
Syllabus is too vast; Learners attitude towards Maths	16.7
Too much content in primary school and too little time	16.7
Missing	50.0
Total	100.0

C3 What may be the factors that may contribute to a gap between the primary and secondary phase?	**Percent**
Fewer subjects in the foundation phase	16.7
Lack of consultation between primary and secondary school educators	16.7
Language barrier	33.3
No consolidation and continuation	16.7
Qualifications of Educator: non-specialists teach Maths	16.7
Total	100.0

C4 What factors may possibly contribute to the difficulties experienced in teaching Maths at primary school?	Percent
Attitudes of Learners and poor parental support	16.7
Content	33.3
Lack of teaching aids and resources; Unqualified teachers	16.7
No specialist Maths Educators	16.7
Poor reading and understanding	16.7
Total	100.0

C5 Are all teachers who teach the lower grades Maths at your school are Maths specialists?	Percent
Yes	33.3
No	66.7
Total	100.0

C5Comment	Percent
Educators are trained by phase, not by subject	16.7
They become specialists	16.7

Eighty-three percent of primary school teachers stated that there are insufficient professional development workshops to train Maths teachers. They reiterated that there is only one for the year and the facilitator is not a Maths specialist. Taylor (2010: 7) argues that because much in-service training was failing to bridge that capacity gap, the monitoring of teaching and learning was weak or non-existent at many schools. The majority of respondents mentioned that workshops should be on-going and feedback needs to be implemented Primary school teachers mentioned that the following may be factors that contribute to a gap between primary and secondary phase Mathematics*:*

"Lack of consultation between primary and secondary school educators… fewer subjects in the foundation phase ...no consolidation and continuation…. qualifications of educator: non-specialists teach Maths…. language barrier."

They also stated that the following were factors that contribute to the difficulties experienced in teaching Maths at primary school:

"Attitudes of learners and poor parental support….poor reading and understanding is a big problem….lack of teaching aids and resources….unqualified teachers…. no specialist Maths educators."

Slavin *et al.* (2009: 854) also concur that parental involvement is beneficial and parents should work together with the school to provide learners with opportunities to help their children achieve success.

Sixty-six of respondents reiterated that all teachers who teach Mathematics at their schools are not Maths specialists. The DoE ruling on specialization of subjects is that if a teacher teaches a specific subject for five years, they are regarded as specialists in those subjects rather than basing specialization on subject qualification. According to Hassel (2014: 3), subject specialization in the US enables excellent elementary teachers to reach more students by focusing on their best subjects and teaching those core subjects to two or more classes of students, rather than just one. He further emphasized that managers should monitor the pace and progress of teaching and learning and ensure that learning activities were set at the right level of complexity for each grade, and that learners were stimulated to achieve their potential. These teachers save time by narrowing their subject coverage and utilizing their skills more efficiently at primary schools.

5.30 Section D: Questions on teacher efficacy

As shown in Table 5.44, Table 5.45 and Figure 5.24, there were significant relationships between teacher efficacy and learner expectancies and perceived performance in Mathematics at primary school, and an even stronger relationship between teacher efficacy and learners.

Table 5.44: Primary school teacher efficacy

	Agree	Neutral	Disagree
D1 If I try really hard I can get through to even the most difficult or unmotivated student	66.7		33.3
D2 If some students in my class are not doing well in math, I feel that I should change my approach to the subject.	50.0		50.0
D3 By trying a different teaching method, I can significantly affect a student's achievement.	66.7	33.3	
D4 There is really very little I can do to insure that most of my students achieve at a high level.	33.3		66.7
D5 I am certain I am making a difference in the lives of my students.	100.0		

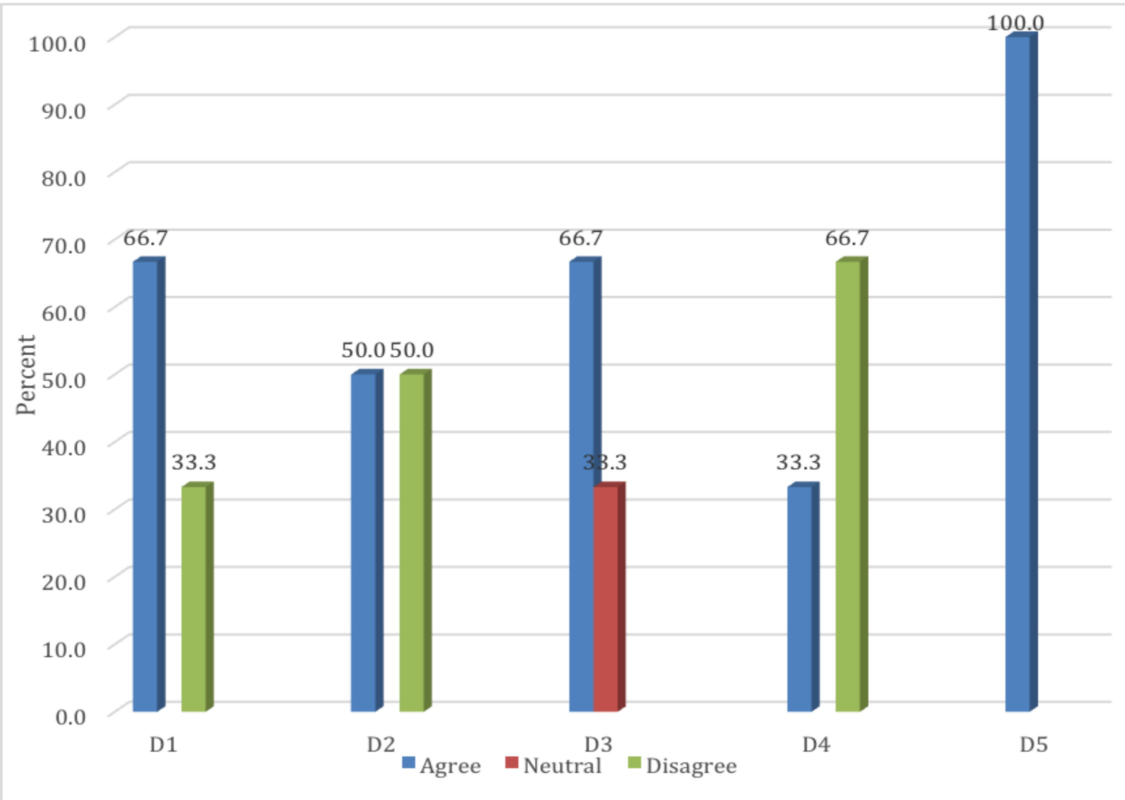
All 100% teachers indicated that they are making a difference in the lives of their students. Fifty percent of teachers disagreed that if learners were doing poorly in Mathematics then they should change their approach. Probably if the 50% of the primary school teachers tried to change their approach to teaching Mathematics; it may result in improving learners' performance because 66.7% of the respondents agreed that by trying a different teaching method, they can significantly affect a student's achievement.

Table 5.45: Secondary school teacher efficacy

	Agree	Neutral	Disagree
D1 If I try really hard I can get through to even the most difficult or unmotivated student	60.0	20.0	20.0
D2 If some students in my class are not doing well in math, I feel that I should change my approach to the subject.	80.0	0.0	20.0
D3 By trying a different teaching method, I can significantly affect a student's achievement.	60.0	40.0	0.0
D4 There is really very little I can do to insure that most of my students achieve at a high level.	20.0	40.0	40.0
D5 I am certain I am making a difference in the lives of my students.	50.0	20.0	30.0

Eighty percent of the secondary school teachers agreed that if some students in class are not doing well in math, they feel that they should change their approach to the subject. Another 60% of the teachers agreed that if they try really hard they can get through to even the most difficult or unmotivated student and 60% also agreed that trying a different teaching method, they can significantly affect learners' achievement. A further 50% were certain that they were making a difference in the lives of their learners. It can be articulated from this sample of respondents that teachers with a more positive sense of teaching efficacy believed that they could improve their learners' performance in Mathematics.

Figure 5.24: Primary school teacher efficacy



Even though the researcher had asked primary school teachers to focus on the Mathematics domain, most of them teach their learners other subjects as well. Their answers to the efficacy measure could be based on their feelings about their effectiveness beyond the Mathematics domain and therefore not have as strong a relationship to learner beliefs in Mathematics as do the efficacy beliefs of secondary school Mathematics teachers. These findings concur with that of Carron and Chau (2009) and Mullens *et al.* (2011) who concluded that teachers who possessed good pedagogical skills impacted positively on educational quality since learner achievement depends on teachers' command of subject matter and their ability to use that knowledge to help students learn. Ball *et al's*. (2008: 25) study indicates that strong mathematical content knowledge is essential for quality teaching in Mathematics.

Figure 5.25: Secondary school teacher efficacy

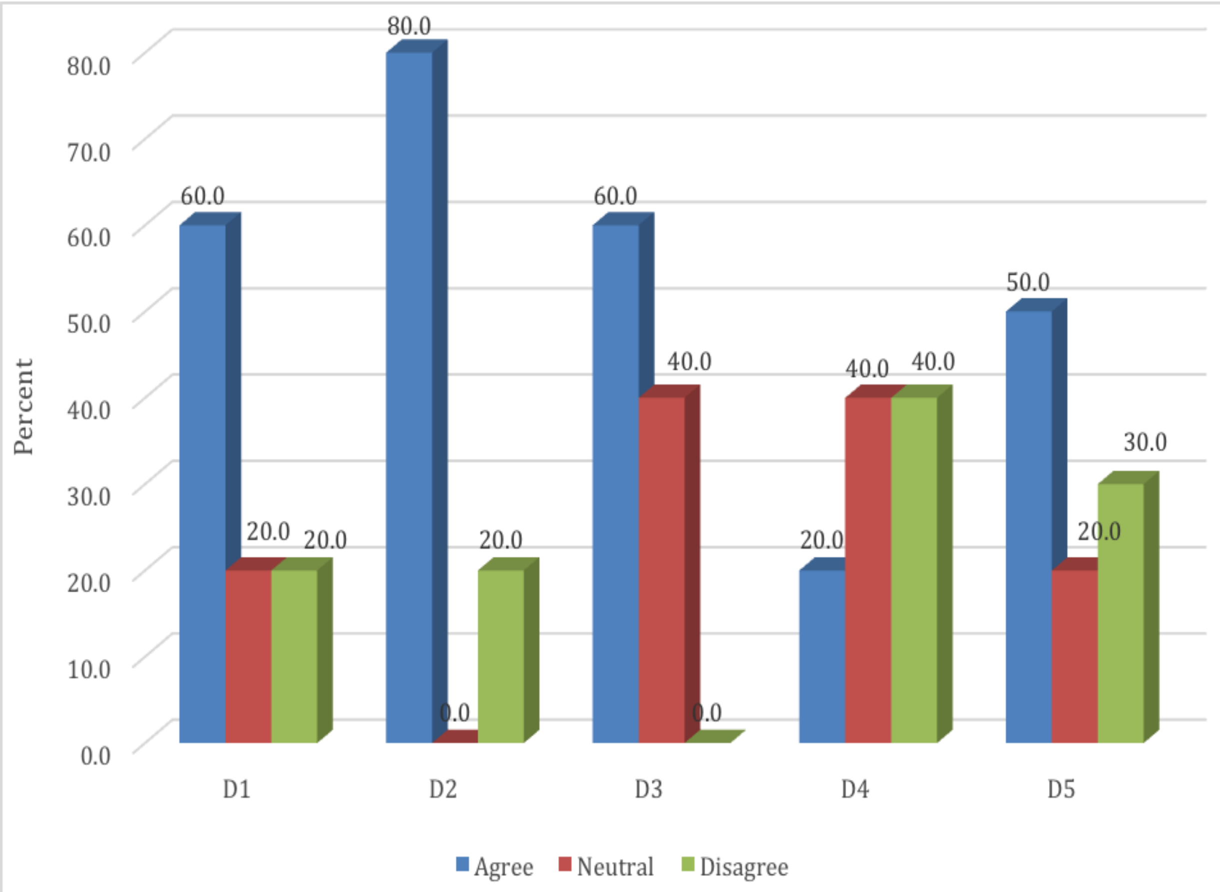


Table 5.45 and Figure 5.25 indicate secondary school teacher beliefs have shown a change in relationship between teachers' beliefs about their personal efficacy and learners' beliefs about their performance and potential in Mathematics and the difficulty of the subject matter. Learners suffer the most in terms of attitudinal change in secondary school and end up with low expectancies and perceived performance

and high perceptions of task difficulty. Only 20% of teachers state that there is really very little they can do to ensure that most of their students achieve at a high level; 40% are not sure; and another 40% disagree. Teacher efficacy beliefs could bring about changes in low-achieving learners' perceptions in Mathematics. This finding concurs with Bandura’s (1986: 32) theory of self-efficacy that states that successful experiences lead to greater feelings of self-efficacy and failing to deal with a task or challenge can also undermine and weaken self-efficacy. In light of the theory, when a learner sees their teacher in a positive light, it can increase self-efficacy. However, the opposite is also true and seeing someone similar to one fail can lower self-efficacy. Hence, when teachers encourage and convince learners to perform a task, they tend to believe that they are capable of performing the task. Therefore, the ideology of this theory is that constructive feedback is important in maintaining a sense of efficacy as it may help overcome self-doubt in learners.

5.31 Section C: Secondary school teachers’ open-ended questions

Table 5.46: Secondary school teachers open-ended questions

C1 Do you perceive a gap between primary and secondary school Maths?	Percent
Yes	80.0
No	20.0
Total	100.0

C1 Comment	Percent
A stronger foundation is required at primary school level	20.0
Introduction of new concepts; Level of work is much more difficult	20.0
Major difference in content and the amount of work done	20.0
Many learners do not know basic concepts	20.0
The CAPS curriculum ensures coherence	20.0
Total	100.0

C2 In your opinion are the learners who come from primary school adequately prepared for secondary school Maths?	Percent
No	80.0
Not always	20.0
Total	100.0

C2 Comment	Percent
Background knowledge in certain sections is limited or poor	20.0
Concepts have to be re-taught	20.0
New topics are foreign; Cannot link primary school Maths to secondary school	20.0
Rely too much on the calculator	20.0
Missing	20.0
Total	100.0

C3 What may be the factors that may contribute to a gap between the primary and secondary phase.	Percent
As above	20.0
Curriculum is vast and beyond the cognitive abilities of learners	20.0
Many new concepts are introduced; Learners are introduced to algebraic expressions	20.0
Pass rate requirement is too low	20.0
Quantity of work that needs to be done	20.0
Total	100.0

C4 Do learners grasp concepts taught in Maths easily?	Percent
No	80.0
Not always	20.0
Total	100.0

C5 Do learners perform better in algebra and substantially worse in geometry?	Percent
Yes	100.0
C5Comment	Percent
Geometric calculations of angles	20.0
Inability to see patterns	20.0
Learners find it difficult to apply theoretical frameworks to problems	20.0
Takes time to teach spatial sense	20.0
Missing	20.0
Total	100.0

C6 What factors may possibly contribute to the difficulties experienced in teaching Maths at the secondary school?	Percent
Curriculum overload; Level of content; Learner apathy; Discipline; Socio-economic barriers; Resources	20.0
Lack of resources; Vast syllabus; Levels of Maths not the same from feeder schools; Too little time	20.0
Larger numbers of learners; No on-going support structures	20.0
Learners do not know basic theorems; Language barrier hinders comprehension; Content is too vast; Time is limited	20.0
Learners not doing the correct Maths computation; Poor understanding of basic concepts; Poor skills acquired	20.0
Total	100.0

A majority, 80% of the respondents, also affirmed that learners who come from primary school are not adequately prepared for secondary school Mathematics. Twenty percent of all respondents mentioned that a stronger foundation is required at primary school level, when introducing new concepts as learners find the level of work much more difficult; there was a major difference in content and the amount of work done at secondary schools; and many learners do not know basic concepts and the CAPS curriculum should ensure coherence. Twenty percent of the teachers noted similar comments about primary school learners, such as

"Basic concepts are not understood…. learners cannot grasp abstract Maths concepts…. learners find it difficult to relate to certain aspects…. new topics are foreign; they cannot link primary school Maths to secondary school…learners not doing the correct Maths computation…. poor understanding of basic concepts; poor skills acquired…. learners find it difficult to apply theoretical frameworks to problems… rely too much on the calculator."

The majority of teachers stated the difficulties experienced in teaching Mathematics at the secondary school as follows:

"Curriculum is vast and overload. Level of content…learners are apathetic…attitude is poor….discipline; socio-economic barriers…lack of resources…vast syllabus….levels of Maths not the same from feeder schools….time is limited….larger numbers of learners….no on-going support structures."

A significant 100% of teachers were adamant that learners perform substantially worse in geometry, which is problematic in teaching Mathematics at secondary schools. Four of the five statements have higher levels of agreement. Sixty percent of respondents from the secondary schools stated that they perceive a gap between primary and secondary school Maths as seen in Table 5.48 and a staggering 80% affirmed that learners who come from primary school are not adequately prepared for secondary school Mathematics. This finding provides a possible relation to the World Economic Forum report (2014: 2) that primary school teachers are battling with the simple arithmetic they are meant to be teaching and, according to their survey of education in South Africa; Mathematics teachers are struggling with simple aspects taught at primary schools. Therefore, Mathematics performance is not very good in the broader context of what one expects from the primary level. Another 60% of Mathematics teachers agreed that learners do not grasp concepts taught in Maths easily and a majority (80%) of teachers indicated that learners perform better in algebra and substantially worse in geometry. Secondary school Mathematics teachers experience obstacles in performative productive practice because learners cannot

engage in activities that allow them to master the SKAV needed in the secondary phase Mathematics and this has a ripple effect into other preceding grades. Therefore secondary phase Mathematics learning is a concoction of activities, from primary to senior phase and FET that impedes the development of SKAV. This ties up with Bernstein's (2010: 8) research findings which show that there are crucial weaknesses in some areas of the overall schooling system. Spaull and Kotze (2015: 7) concur with Bernstein (2010: 8) that these are especially found in Mathematics. They also confirmed that this is directly related to un-qualified and under-qualified teachers and inadequate coordination of the schooling system's various levels and components. Asked what the teachers' attitudes were towards CAPS, the teacher replied:
"You know this curriculum (CAPS), it's not a new curriculum but not much difference from the previous one... we have to be trained on this in no time and this has to be implemented... as I have indicated with resistance, why do we have to? Some would even complain that we are learning nothing new although what they are doing in the workshop supposed to be the policy and this should help all teachers, instead it is a waste of valuable teaching time."

These evolving problems demonstrate that teachers are defined in unstable relations in the school situation. This alters the "optical density" of the various nodes in Figure 2.1 (chapter 2) and impinges on how teaching and learning take place that determines which SKAV are currently in practice. It is apparent from this finding that proper revised teacher training should encourage the practice of quality education as the basis of continual improvement of teaching and educational methods as advocated in Jansen's (2015: 19) finding. This also hinges on the activity theory which is essential since all activity is shaped by the context within which it occurs (Bertelsen and Bodker 2003: 9). The alliances formed expose the tension with the network. It is these alliances that indicate where the gaps are in this network, which associations are failing the dissemination of the network.

5.32 Comparison of teachers' satisfaction and dissatisfaction factors

Table 4.47 describes that working conditions, opportunity for promotion; salary; acknowledgement in profession; management, DoE personnel; teaching resources;

high workload/low status/rude behavior; and career opportunities have an influence on the Mathematics teachers' job dissatisfaction.

Table 5.47: Teachers satisfaction factors and dissatisfaction factors

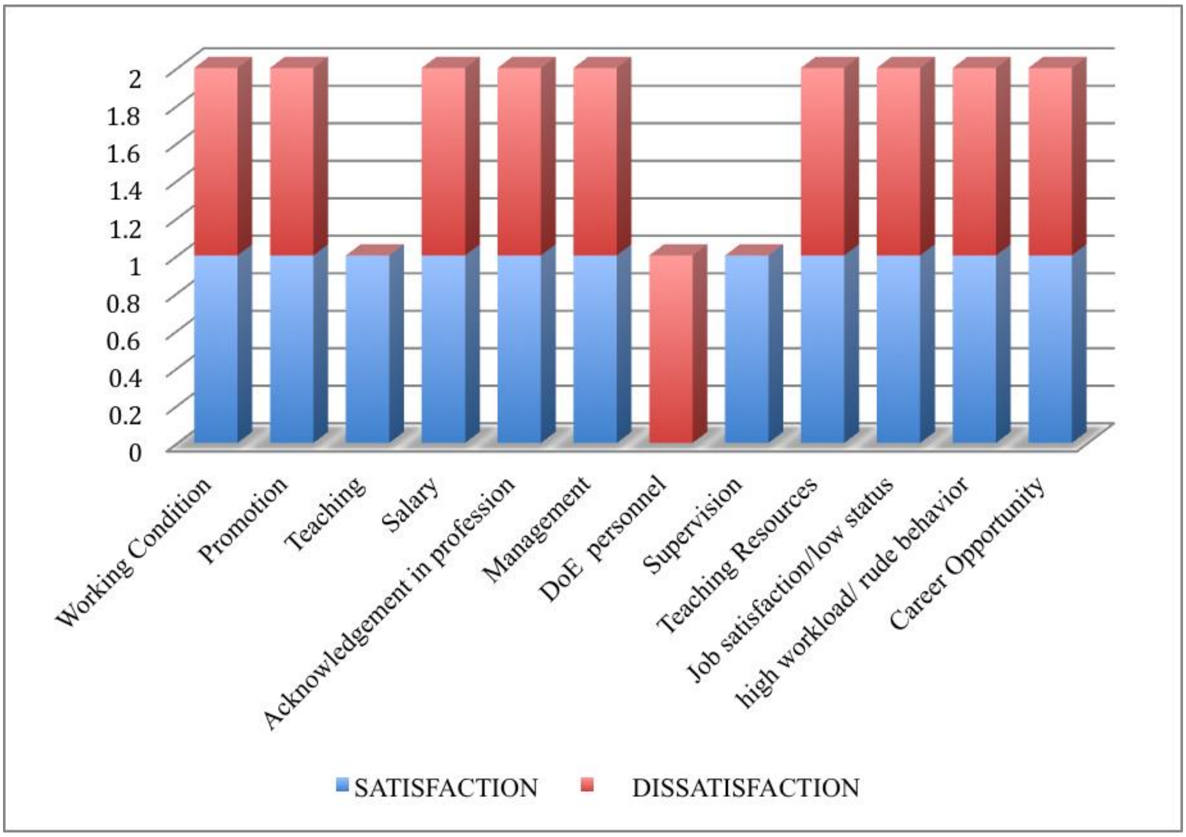
FACTORS	SATISFACTION	DISSATISFACTION
Working Condition	1	1
Opportunity for Promotion	1	1
Teaching	1	0
Salary	1	1
Acknowledgement in profession	1	1
Management	1	1
Department of Education personnel	0	1
Supervision	1	0
Facilities - Teaching Resources	1	1
Job satisfaction/low status	1	1
Others (high workload/ rude behavior)	1	1
Career Opportunity	1	1

0=Factors does not affect satisfaction/dissatisfaction of teachers
1=Factors affect satisfaction/dissatisfaction of teachers

The findings of the study revealed that some factors, reported by teachers as contributing to their job satisfaction and job dissatisfaction, were in a positive direction and other factors were in a negative direction. Achievement, recognition and promotions, acknowledgement in profession, rude behavior of peers or management contributed predominantly to teacher dissatisfaction. Supervision and teaching have no influence on the job dissatisfaction. Further, the satisfaction factors identified for teachers tend to focus on the work itself and the dissatisfaction factors tend to focus on the conditions of work. The results of this study tend to support the universality of Herzberg's (1964: 61) findings. Taylor (2010: 7) stated that teachers were generally dissatisfied with promotional procedure whilst managers should provide a conducive work environment for teachers to teach without interference and principals should be in serviced on good management so as to motivate their teachers.

Figure 5.26 shows that the Mathematics teachers' job satisfaction factors and dissatisfaction factors are similar to the satisfaction and dissatisfaction of the existing trends and some of the factors are not similar to each other. Results shows that teachers' job satisfaction factors are slightly more than dissatisfaction factors.

Figure 5.26: Teachers satisfaction factors and dissatisfaction factors



The respondents stated that working conditions; opportunity for promotion; salary; acknowledgement in profession; management; teaching resources; high workload/ rude behavior and career opportunities have influence on the job satisfaction/ low status whereas DoE personnel have no influence on teachers' job dissatisfaction. These findings point to Bernstein's (2010:19) findings that teacher quality is clearly lacking due to the selection, appointment and promotion of teachers not on the basis of their teaching qualities but to the teachers' other relationships or affiliations. This leads to further tensions and work dissatisfaction.

According to Livingstone (1999: 11) human capital theory suggests that great efforts are required to lead to economic gains. The low performance levels on standardized tests such as TIMSS, ANA and the NSC examination. The curricula and pedagogies of current educational systems are changing and education departments should continue to try to improve the quality in teaching and learning to bring about economic growth in South Africa.

5.32 CONCLUSION

This chapter focused on the presentation and interpretation of data that was obtained from the quantitative and qualitative study. Several statistical techniques were used for the interpretation and analysis of data. This was dependent on the type of data being analyzed. Descriptive and inferential statistics were used to interpret the qualitative data presented by respondents. Furthermore, factor analysis was used primarily for data reduction purposes. This technique helped in establishing the commonality of a given variable. The Varimax Method with Kaiser Normalization was used to minimize the number of variables so that scientific deductions could be made. Inferential statistical measures such as the Cronbach's alpha test were used to determine the reliability of the questionnaire. Moreover, the Pearson Chi-square test was employed to establish whether there was a statistically significant relationship between the variables. The relationship formed at primary, secondary schools and DoE expose the problem and tension within the network. There are gaps in this network, with associations that are failing the propagation of the network. These gaps need to be bridged as this causes transgression in the network. Emanating from the empirical evidence of this study, the results and findings were examined against the background of education policy making and implementation within the context of a public administration paradigm. Quantitative and qualitative data were analyzed under specific headings and sub-headings and were presented in an integrated manner using interactive statistical tables and graphs. Eventually, arising from the interpretation and analysis, numerous suggestions and recommendations were proposed which are elaborated on in Chapter 6.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

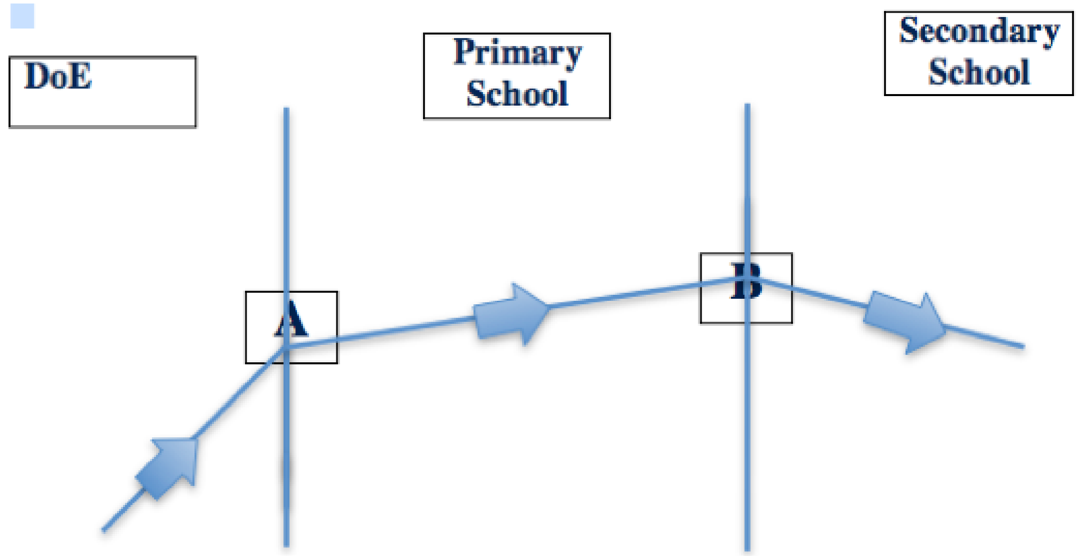
6.1 Introduction

At this stage, the researcher finds it appropriate to provide a little personal background in order to provide recommendations emanating from this study. The researcher is a Mathematics teacher, currently completing a PhD in Mathematics education at the department of Operations and Quality Management in the Faculty of Management Sciences at the Durban University of Technology. Her interest is Mathematics but extends to Mathematics education. The researcher has been a Mathematics teacher for many years and has vast experience dealing with learners and changes in curriculum from apartheid through transformation and post democracy. The researcher is not articulating her concern with the status quo of Mathematics alone, but with numerous other role players and other professional mathematicians. As mentioned previously in Chapter Two, the interface is construed as a point of either convergence or divergence amongst the three nodes of the study, as reflected in Figure 6.1.

6.2 Is there an interface between primary and secondary school?

The findings and analysis in response to the above question are presented at two levels, namely: policy construction and SKAV constitution. The emergent effects of curriculum policy reform are indicated by the point of either convergence or divergence at Points A and B in Figure 6.1. These findings are presented against the background of what was examined in previous chapters, notably the literature review of South Africa's changing curriculum within the context of the various theories and conceptual perspectives of policy development and a comparative study of curriculum trends in other countries. Resulting from the presentation and analysis of the quantitative and qualitative data in the previous chapter, particular trends and scenarios emerged which supported specific conclusions being drawn. Several recommendations are made regarding the quality interface between primary and secondary phase Mathematics that hinge heavily on the mediation of the CAPS curriculum policy and other salient aspects in education, as discussed in Chapter 5.

Figure 6.1: Points of interface



DoE

Strong associations
- Good NSC and ANA results

Weak associations

- Role players anticipation
- Changing curriculum
- Curriculum is difficult to understand
- Training of Mathematics curriculum specialists and understanding of CAPS policy
- Differing understanding of curriculum
- High failure rate in Mathematics

Primary School

Strong associations
- Good ANA results via CAPS mediation

Weak associations

- Role players anticipation
- Differing views of SKAVs
- Changing curriculum
- Non- specialist Mathematics teachers
- Large no. of learners
- Difficult to understand changing curriculum
- One training workshop
- Lack of consultation
- No communication with secondary school teachers

Secondary School

Strong associations
- Good NSC results via CAPS mediation

Weak associations

- Role players' anticipation
- Lack of awareness of SKAVs
- Changing curriculum
- Non- specialist Mathematics teachers
- Large no. of learners
- Difficult to understand changing curriculum
- One training workshop
- Lack of consultation
- Teachers workload
- Lack of professional training

6.2.1 Policy construction: DoE- primary schools interface

At the DoE-primary schools interface, the construction of the CAPS policy in Mathematics is jeopardized from the outset. In essence, the individuals writing these new Mathematics policies have lost sight of the core skills that early Mathematics education should be instilling. In the drive to make the material relevant to the learner, what is being taught has become too applied. It becomes experimental and gets altered, which repudiates the secondary school CAPS Mathematics Policy in terms of its goals and purposes in respect of broadening Mathematics at schools. Goal oriented practices emerge at these two nodes. Therefore, associations are formed with good ANA results. Good results are associated with best practice. The associations formed with the ANA exams in these constructions of policy challenge or divert the policy from its intended transformation process in the primary phase.

6.2.2 DoE-secondary schools interface

The DoE-secondary schools interface also illuminates the construction of policy as a deterrent in terms of its difficult, lengthy content and lack of SKAV for the real world. The DoE-secondary schools interface reveals that policy is constructed as a hindrance across all three nodes. The construction of policy as a hindrance annuls the policy and leads to subversion of policy in respect of assessment and curricula content. In the construction of policy as hindrance, associations are formed with exams at each node. Exams are a means to measure whether schools are flourishing in each nodal network due to their alliance. It is a way for exams to reaffirm the curricula content of the CAPS policy. At these two nodes, goal-oriented practices emerge. Therefore, associations are formed with good ANA and NSC exam results. Good results are associated with best practice. The associations formed with the ANA and NSC exams in these constructions of policy challenge or divert the policy from its intended transformation process.

6.3 SKAV constitution

An analysis of the nodal level from DoE to primary school and then to secondary school reveals that there are interfaces in terms of SKAV development at these nodal points, as reflected in Figure 6.1. The interface is an indication of that the interconnectedness and divergences between the CAPS policy; its mediation and implementation are outcomes of the associations formed at a nodal level. The crux of the matter related to the figure indicates the interfaces in terms of SKAV constitution at the points of convergence and divergence.

A model was developed from the results of this study which could be used for future implementation of policy in the education sector. The subsequent section focuses on the findings and conclusions drawn from the data presented, as well as substantial recommendations are proposed regarding the efficient and successful implementation in the Mathematics classes at primary and secondary schools. This was triangulated with the data presented by the quantitative data and qualitative interviews.

6.4 Capacity building / educational reforms

Despite all the problems resulting from inadequate financial resources, the TIMSS survey has proved to be an extremely valuable experience for all the UNDP participants (South Africa is one of them), resulting in creating valuable capacity for organizing similar surveys at other grade-levels nationally and for participating in TIMSS. The TIMSS survey has led to some meaningful educational reforms in curriculum, evaluation and assessment standards and tests and examinations. This has been most noticeable in CAPS and other leading countries with different curriculum policies. TIMSS has highlighted the need for reforms in Mathematics, especially in such areas as teaching methodologies; teacher training; shifting the emphasis from rote learning to application of knowledge; and new test formats and scoring methodologies. TIMSS has created a renewed awareness of the essential need for educational reforms as a building block for knowledge in Mathematics.

ANA is an assessment tool that annually measures progress in learner achievement. It focuses on the Government's prioritized goal of improving the quality of basic education. Emanating from the ANA in Mathematics is valuable information on the performance of the system at the level of the school, district and province. It is also a reflection of the performance of the schools' and learners' achievement in primary school and early secondary school till Grade 9. The multiple association with good ANA results at the DoE node are powerful.

Another multiple alliance with good NSC exam results at the DoE node is powerful. They mobilize and translate mediation of policy into an increasing pass rate in the NSC exams. Associations are also formed with teachers and good NSC exam results in the construction of their pedagogical identity in order to motivate them to produce good NSC exam results. It is interesting to note that the synergized alliance formed with good NSC exam results at the DoE node restructures itself and emerges as an exam alliance at secondary schools.

This means that the good NSC exam results, ANA pass rate and TIMSS results are alliances initiated at the DoE node, which is under pressure at the secondary and primary school nodes. In other words, the alliance network evolves in response to needs, associations formed, conflicts and negotiations at a nodal level with policy mediation.

6.5 Conception of capacity for instruction

In practice, the national Department of Basic Education (DBE) develops policies while provincial departments are charged with the responsibility of implementing the policies. The administrative tier between the province (DoE) and the school is the district. Being at the point where the DoE interfaces directly with the primary and secondary schools, districts are ideally positioned to provide professional support to schools. The DoE is expected to provide management and professional support to schools in order to improve and maintain high quality teaching and learning in Mathematics. The DoE is established through education, and education is helping to shape this new social order. There remains a powerful role for education to challenge the old, the continuing and the new inequalities and injustices.

6.6 Lack of consultation

In essence, the individuals writing the new CAPS policy have lost certain SKAVs that are synonymous with Mathematics and what it should be instilling. Evidently, the Mathematics CAPS policy could not provide holistic recommendations as stakeholders were not represented. It is evident from the information presented in

Chapter 5 that Mathematics teachers were not consulted on the national curriculum. Therefore, it may be construed that the process was privy to only a specific group of elite or handpicked Mathematicians to shape the curriculum for the whole country. The process was not democratic but rather surreptitious and lacked consultation at grass roots level. The real tragedy is that in democracy there is transparency and when the main role players are not consulted, the policy can be skewed. Data reveals that several factors affect teacher learning and change during the launch and implementation of new curriculum reforms. These factors include perspectives and assumptions about teacher learning and change held by district officials. A common assumption was that teachers were resisting change, a belief that was hardly investigated, thus qualifying it as merely an "assumption". Teachers were not afforded an opportunity to contribute to the CAPS policy nor were they allowed reasons for their supposed resistance towards change and their grievances about the new curriculum reforms. So what do mathematicians see as the problem? I would say that it is, in essence, that the individuals writing these new Mathematics programs have lost sight of the core skills that early Mathematics education should be instilling.

Teachers have raised concerns that learners have difficulty at the secondary node where basic skills in Mathematics are lacking. For learners in primary and secondary schools, problems have been observed to be due to a lack of proper understanding of mathematical language and a misinterpretation of mathematical concepts. Learners' problems in Mathematics may increase with the implementation of national education reforms. Though designed to improve access to education for all and raise the quality of education, these reforms are likely to pose problems to both teaching and learning. For example, teachers' methods of teaching and assessing Mathematics at schools may also need to be reformed. In addition, the teaching and evaluation of integrated mathematical skills to learners with learning difficulties at schools under the present curriculum reforms is quite challenging. To be successful, these curriculum changes may require a reform.

6.7 The gap between primary and secondary school

Attention needs to be given to discontinuities in teaching approaches and curriculum topics. A key skill in Mathematics is abstraction, namely: the ability to abstract away from real world objects and manipulate these abstractions to draw deep results. This is vital. Abstraction is fundamental to Mathematics. It is what gives Mathematics both its power and its scope and it is the mechanism by which secondary school Mathematics is built upon from primary school Mathematics. Abstraction and abstract thinking is one of the core skills that Mathematics education should be imparting, yet it is invariably ignored by these new Mathematics curricula. The real tragedy is that because Mathematics is a heavily layered subject with each new topic building upon the previous ones, once learners fall behind in primary school, catching up can be an insurmountable effort. Indeed, learners are often confronted by a great challenge in secondary school when their limited mathematical repertoire fails to provide the necessary SKAV to fully grasp the next topic. Even worse, by failing to impart the core skills of abstraction and logical systematic approaches to dealing with abstract objects, learners are denied the very skills necessary to even begin to expand their mathematical SKAV. At its heart, Mathematics is about abstract and logical thought and without these core skills, no learner can hope to succeed in Mathematics.

The gap between learners' perceptions and expectations of secondary school give learners a rude awakening in Mathematics when they enter secondary school. Helping Mathematics teachers develop strategies for assisting learners; manage their own learning; giving learners the opportunity to overcome difficulties on aspects they do not understand, particularly relating to classroom learning and flexible learning and teaching, which takes into account differences in learners' preferred learning styles is necessary. It can also be argued that the impact of transition from primary to secondary school; pedagogy; and teacher-learner relationships may have implications for different learners. Teachers should strive to work on building sound and positive academic relationships with their learners.

6.8 Specialist teachers

The majority of primary schools do not have the Mathematics specialist teachers needed to provide a high quality Mathematics education. The data revealed that Mathematics in primary and early secondary education has a serious shortage of specialist Mathematics teachers. The problem identified includes a significant lack of Mathematics teachers in schools. Early Mathematics is a particularly formative time for young children when they can either be inspired by the way that Mathematics helps them to understand the world around them or be de-motivated from exploring it. Government should look into getting assistants for Mathematics. Learning coaches and teaching assistants are paid less than certified teachers because these roles do not require high levels of academic content as practiced in the US (Hassel 2014: 2). Some teachers engaged in the teaching of Mathematics prior to the implementation of the CAPS Mathematics policy document. All of these peculiar problems experienced by primary school Mathematics teachers who underwent further training for the implementation of CAPS in Mathematics and other subjects they teach may impact negatively on the learners. Those learners who had negative experiences at primary schools then go into secondary school with a lack of understanding in Mathematics.

The data highlights that failing to have clear definitions of what is meant by primary specialists in Mathematics is stifling the development of a clear CAPS policy document. As long as there is this lack of specialization in Mathematics at primary and early secondary school, attempts to improve the quality, delivery and effectiveness of Mathematics will continue to be prevented.

6.9 Ongoing professional development

Professional development can help overcome shortcomings that may have been part of teachers' education and training and keep teachers abreast of new knowledge and practices in the field of Mathematics. This ongoing training for teachers can have a direct impact on learners. To ensure effective curriculum support, all districts should ideally have one appointed Mathematics curriculum specialist. As a matter of urgency, all vacant curriculum specialist posts, should be advertised and the best candidate for those posts should be based on merit. This would ensure that curriculum delivery gaps are filled. Moreover, the training workshops for new primary and secondary school Mathematics curriculum specialists should be of high quality and include aspects pertaining to both content and assessment that would reinforce the implementation of CAPS.

Teachers are critical determinants of learners' learning and educational progress and they must therefore be well trained to use effective teaching practices. A longstanding and problematic tradition in teacher education is the treatment of teacher preparation and professional development as disparate phases of a teacher's career continuum. It is more productive that teacher preparation, induction and professional development are critical areas of teacher learning rather than fragmented programs, institutions, or policy levers each governed by its own mandates, beliefs and practices. Mathematics teachers must know not only the content they teach but also how learners' knowledge of Mathematics is developed and structured; how to manage internal and external representations of mathematical concepts; how to make learners' understanding of Mathematics visible; and how to diagnose learner misunderstandings and misconceptions, correct them and guide them in reconstructing complex conceptual knowledge of Mathematics.

Before asking teachers to take on this new challenge of policy reform, Mathematics curriculum specialists should dig deeper than the ostentatious phrases and poorly defined buzzwords that tend to characterize the 21st century skills movement. As a first step, they should make a serious effort to understand the best empirical evidence on what skills will be necessary for learners to succeed in careers and personal lives and they should communicate that information in clear and concrete ways that make sense to the Mathematics teachers who will be ultimately responsible for teaching them. Simply asking teachers to address a long list of inadequately defined skills will not be sufficient. These issues include the continuous lack of teacher support necessary for the new reform implementations.

As a systems change initiative, the DoE should offer a framework that supports the design of instruction that integrates many variables and variations of learners' and educators' needs. However, the potential for change cannot be realized without significant and on-going training and professional development of all professionals involved in the system of education. A dramatic change in the standard and availability of Mathematics training for primary school teachers is needed and they also need to be supported by the DoE, private sector and the wider Mathematics community in order to improve learners' mathematical understanding on entering secondary schools. Continued professional development training workshops in CAPS education would be beneficial not only for teachers and learners but also for administrators of educational systems.

6.10 Self-efficacy: positive experiences

The disturbing fact is that most learners at secondary schools believe that Mathematics is difficult and incomprehensible. Learners fear that which they do not know or that which they have had scary experiences in the past. Therefore, the real challenge is how to motivate learners to want to study and learn aspects in Mathematics and how to teach them in a stimulating and understandable manner. Self-efficacy (beliefs about one's ability to accomplish specific tasks) influences the tasks they choose to learn and the goals they set for themselves. Self-efficacy also affects teachers' level of effort in teaching. As stated by Zimmerman (2000: 89), self-efficacy beliefs increased the prediction of academic outcomes. Students' self-efficacy beliefs are responsive to changes in instructional experience and play a causal role in learners' development of academic competencies. A majority of secondary school learners had poor self-beliefs about academic capabilities which has a negative impact in their motivation to achieve. Whilst perceived self-efficacy for learning correlates positively with learners' rates of academic performance in Mathematics, these formed a minority of learners. Some teachers who displayed a poor sense of efficacy may influence both their motivational and instructional strategies. In Bandura's studies (1997: 37), high teacher sense of efficacy was significantly related to the maintenance of a warm, accepting classroom climate that results in a progressive classroom environment. The learners' development is influenced in the microsystem, which is the classroom environment; mesosystem the home environment; exosystem and macrosystem, which impacts on all other spheres of learners. Numerous teachers highlighted a lack of parental support and poverty during the interview and this is another hindrance to progressive quality learning.

6.11 Resource materials

The inadequate provision of Mathematics resources in particular was a specific concern raised by respondents. In order for CAPS to be implemented satisfactorily, teachers required good quality resource materials to supplement their teaching, especially in the new content areas. Therefore, it is without doubt that more attention should be paid to the type of textbooks and learning materials that are provided to Mathematics teachers. Some of the textbooks at schools were obsolete and highly questionable in terms of quality teaching and learning. Another finding showed that most Mathematics textbooks did not include the prescribed content of CAPS because of all the curriculum changes over the years. Resources and support materials from DoE for Mathematics content areas that did not appear in school textbooks are distributed towards the latter part of the year, when it is too late. It is of great concern since textbooks serve as a critical resource in ensuring that the curriculum is effectively implemented. In addition, textbooks play a significant role in consolidating the lesson that was taught in terms of content and assessment activities that learners can engage with in class or complete as homework. Mathematics teachers reiterated that poorly resourced schools lead, in some cases, to poor results and poor quality of teaching and learning. A number of recommendations have been made with regard to improving the status quo of Mathematics.

6.12 Recommendations

It is recommended that primary school Mathematics is taught by specialist Mathematics teachers. To overcome this shortage of specialist teachers, the number of Mathematics specialist teachers should increase at tertiary institutions. The Government must increase the number of Mathematics specialist teachers at primary school to ensure that all children have the best start in Mathematics. Curricula content should have continuity from primary to secondary school and Mathematics should be more challenging in primary school. The level of pedagogic practice, assessment and liaison activities should increase proportionally from primary to secondary school. Teachers and schools can ensure that learners maintain their engagement with Mathematics as they enter secondary school in the following ways:

- ❖ Build transition programs that promote collaboration between primary and secondary schools;
- ❖ Invite secondary school Mathematics teachers to visit and observe and perhaps teach primary school Mathematics lessons, and vice versa;
- ❖ Hold joint parent and student information sessions that explain pedagogy and the Mathematics curriculum expectations;
- ❖ Attend professional learning aimed at early secondary years Mathematics pedagogy and content; and
- ❖ Be familiar with Mathematics curriculum requirements at both primary and secondary levels.

The implication of a relational approach is that the process of SKAV development aimed at addressing the backlog in Mathematics teachers' development and overcoming the skills shortage in Mathematics cannot be confined and relegated to the schools node. The findings of this study lead to the notion of partnership formations at the three nodes of the study – DoE, primary and secondary schools to facilitate the reforms being advocated and to reconcile the divergent agendas in respect of the development of competencies related to Mathematics.

The DoE needs to ensure that training programmes are offered to educators are of a high standard. Policy makers should consider the importance of teacher professional development programs. Professional development programs provide diverse programs based on various demands from primary teachers who have different educational backgrounds and teaching experience. It is alleged that ill- equipped DoE training officials are dispatched to schools to facilitate the process of implementation through workshops, etc. and then is perceived failure of HEIs to develop or revamp their existing teacher training programmes for purposes of catering for the demands of the new curriculum. Facilitators should be thoroughly trained to offer guidance to teachers to teach and assess CAPS to learners in the classroom. Due to the intense need to address and undo the injustices of apartheid education and confront the contemporary demands of the society, the South African government has devised numerous strategies to address these imperatives. However, through teacher training institutions' programmes and approaches in addressing the general pedagogic, political and economic imperatives, these challenges can easily be dealt with.

Facilitators, together with lecturers from HEIs, should establish teams of Mathematics subject experts to facilitate training workshops for teachers throughout the country. In this way, gaps in the system would be closed and there would be consistency in terms of the content and assessment material that is being presented to educators.

The duration of the training workshops for CAPS was too short. The training workshops on the new curriculum were not accompanied by any details as to how educators would actually implement the radical new ideas, especially in under-resourced schools. It is incumbent upon the curriculum specialist to determine the needs of particular Mathematics phases. Training on specific aspects of new content and assessment should be ongoing. Professional development of teacher education in Mathematics should be sustained and teacher learning should continue throughout the teacher's career as it is critical to the advancement of teaching and learning at schools. It is therefore recommended that teachers undertake high-quality training or to improve their qualifications throughout their careers in order to keep abreast and update their knowledge, as well as re-invigorate their teaching.

There is growing recognition that the current system of incentives needs to be based on qualifications and length of service in order to recognize and reward best teachers. More needs to be done to attract talented individuals to the teaching profession and to ensure that high-performing teachers and principals are working in those schools where they are needed and where they can make a difference. We can learn from the experiences of the United Kingdom and the United States of America where such programs bring together businesses, charitable organizations and government to attract the best and most highly qualified graduates to teach Mathematics at schools. In view of this, regular in-service training should be given to the teachers to improve teaching skills and performance. For example appropriate programmes can also be started to improve teaching Mathematics skills in primary schools leading to secondary schools. A rethinking focused on the curriculum and training of trainee teachers at primary and secondary school level and the different processes used to acquire the teaching skills are major pillars that should underpin the South African education system. In addition, emphasis on the necessity of sufficiently exposing teachers to the field of work experience by means of well-designed microteaching lessons and placement system should be thoroughly monitored by tertiary institutions.

The burden of assessment and over-reliance on centrally dictated targets has stifled creative approaches to teaching and learning in Mathematics and has severely limited learners' experiences in Mathematics. It is also more important for educational departments to be thinking actively and creatively about what they are trying to achieve than to expend energy on complying with the standards of evaluation only. Too much focus on the details and specifications of the evaluation process can lead to too little focus on the overall objectives of teaching and learning. Generally, too much emphasis on compliance with the process specifications of evaluation can lead to individuals losing their judgment and expertise appropriately.

The pressures on teachers and schools have been so great that too much classroom time has been dedicated to focusing on mathematical retention, rather than introducing the excitement and inspiration of Mathematics through practical work. Teachers are also pressured to help learners obtain high scores in public examinations, which may conflict with learners' genuine understanding of mathematical concepts. This over-emphasis on "teaching to test" has masked an insufficient understanding of basic mathematical concepts, which becomes problematic at secondary level when the subject becomes more demanding. In line with their varied levels of experience and expertise, the teachers varied widely in their levels of mathematical self-efficacy with some feeling overwhelmed because of teaching the subject for the first time or being inadequately supplied with curriculum materials; whilst a few others felt on top of the game and stated that they could be involved as resource persons. This study provides evidence that changes in the classroom environment with regards to changes in teacher efficacy beliefs from primary to secondary school are related to changes in learner beliefs about their performance and potential and about the difficulty of the subject matter in the Mathematics domain. Learners who move into classrooms taught by teachers with a low sense of efficacy do show the commonly reported developmental decline in self and task beliefs after the transition to secondary school. In contrast, learners who move into classrooms taught by teachers with a high sense of efficacy show either less negative change or some positive change. Perhaps, then, it is not inevitable that so many children suffer a decline in their motivation and performance when they move to secondary school. If most learners moved to more efficacious teachers after the transition rather than to less efficacious teachers, developmental patterns of change in learner motivation and performance would be different.

There has been a decline in the way teachers are viewed and the overall ethos of the profession has also waned. This can only be improved if the teaching profession is given due recognition and status. The results have also shown that teachers are demoralized with heavy workloads, handling many lessons, large numbers of learners and working for long hours; together with coaching in various codes of sporting activities and other associated tasks. It is difficult for them to give personalized attention to all the learners; conduct assignments and assessments; to test what has been taught; and take full control of their classes. This affects the ability of teachers to identify learners' weakness and assist them. There is a likelihood that this would affect the quality of education given to the learners, especially in core subjects like Mathematics which require constant practice and feedback to gauge learners' progress. The government should engage contract and part-time teachers who are trained teachers to assist. This would therefore ease the teachers' workloads.

There should be a focus, almost to the point of exclusivity, in teaching Mathematics via real-world scenarios. Very limited numbers of Mathematics teachers can connect Mathematics with the real world. Therefore, learners feel that Mathematics is of no use to them. If Mathematics has no connection to the real world, learners' interest will decline and most learners would have negative attitudes towards the subject. Equally, in an effort to nurture learners and foster thinkers, there should be efforts to eliminate rote learning. There may be many ways to arrive at a solution and allow learners to invent their own procedures. Often, these invented procedures are very problem-specific because they may work for the particular problem at hand but fail to generalize to other cases. Ultimately, this results in learners having limited exposure to consistent, systematic, algorithmic approaches. A core skill that Mathematics education should imbue is logical structured thought and a systematic approach to dealing with abstract objects. From the data that emerged, it is apparent that:

DoE should not have abdicated the responsibility of school-based promotions to SGBs. Teachers stated their unhappiness with the nepotism that surrounds promotion posts at school level and reiterated that the status quo at schools are at an all time low due to weak managers. Experienced teachers and teachers who improve their qualifications should be given due credit for persevering to increase their subject content knowledge, which will enhance quality teaching and learning. They should be rewarded and recognized by the DoE. Promotion posts and school managers should be appointed on merit. It would also be useful for education departments to highlight the contribution to improved teacher quality and provide the ongoing availability of further training and development for teachers. District officials should make a concerted effort that teachers implement the reforms in their teaching practices, concurrently ensuring that teacher learning and change and work conditions are attended to on an ongoing-basis. School districts should enhance their communication channels and develop effective working rapport with teachers, as this will facilitate their understanding of various issues confronting teaching at grassroots level. Collaboration with teachers will also give them a better understanding of the complexities involved in the new curriculum reform implementation and how to efficiently and effectively deal with them.

Mathematics textbooks should be carefully screened against specific criteria by subject advisors and curriculum specialists so that there are books which subscribe to the highest quality in terms of curriculum policy, relevant content, as well as assessment activity that should be recommended by DoE. This would enable Mathematics teachers to access a series of textbooks to prepare activities, worksheets and assessments. Preferably, all schools should be encouraged to have one good prescribed textbook for learners in Mathematics per grade rather than a whole range of textbooks. There should be clear policy guidelines on how schools should retrieve loan textbooks from learners. This would compel learners to return loaned textbooks and ultimately save the country a substantial amount of money that can be utilized for other useful purposes in improving quality teaching and learning.

Schools should design appropriate pedagogical interventions for teachers. They need to provide appropriate support in Mathematics, either during school time or during school holidays. There is need to emphasize an academic culture in schools. Schools should be able to focus on the wider needs of learners within and beyond the school to support their wellbeing. Schools must not only commit to excellence in teaching and learning within the classroom but should also be prepared to address the range of external factors that affect learners' ability to engage in learning.

Teachers should evaluate and improve on teacher subject content knowledge in Mathematics. There is an urgent need for teachers to understand and address the range of diverse learning needs in their classrooms. In order to do this, teachers need new skills, training, and support from the educational system. Furthermore, teachers need to find ways to plan and work collaboratively within the different phases for the greatest benefit to their learners.

Communities and parents must take an active role in their children's lives. Motivate young children to see the importance of education. Communities and parents need to motivate and inspire their children to value Mathematics; support and monitor homework; and monitor school reports and learner attendance at schools. There is a need to engage with teachers and school officials about education delivery and performance.

Provincial districts should emphasize providing quality teaching and learning from Grade R and design appropriate pedagogical interventions for teachers. Provincial districts should monitor that textbooks, workbooks and pedagogical resources are in schools timeously and are being used. They should investigate teacher job satisfaction and motivation. Indisputably, no matter how promising the new policies are on paper, they do not guarantee successful teacher learning and change that is required for classroom practices. Expecting teachers to easily comprehend curriculum reforms is naïve and indicates the long way district officials have to traverse in order to achieve the expected changes in the education system. Also, simply training teachers will not permanently change their practices unless their working conditions allow for the desired change. Teachers require time to change and should be persuaded about why they should appropriate them. Workshops are often full of activities and handouts, but they do not help teachers make sense of how to get these ideas conveyed in their own classes. If focus is only on providing activities, then the opportunity to develop teachers to interpret situations, make judgments and take purposeful action that shapes meaning for their learners would be lacking. The research study shows that the role and importance of the district officials in supporting their teachers is indisputable. Teachers need to be supported in various ways, including, as far as the teaching of Mathematics is concerned, by means of on-going training in how to teach Mathematics in the 21st century. The culture of neglect on the part of the district is detrimental to teachers, especially where they are expected to do their best to change an undesirable culture of teaching and learning in schools. It cannot be expected that teachers who have never specialized in the teaching of Mathematics suddenly become experts without the on-going assistance of professional development. The teaching of Mathematics is very demanding and requires a thorough understanding of the subject matter. Teachers with poor subject knowledge will, no doubt, contribute to learners' misconceptions. It is imperative that district officials support teachers to ensure that they do their work to the best of their abilities. There is a need to monitor incidences of violence and bullying at schools and to support principals and schools in managing school safety.

The DoE must develop a practical formal policy on safety at schools in collaboration with stakeholders like community structures, local private security companies, South African Police Service (SAPS), social workers and psychologists. Sufficient human and financial resources must be made available by the DoE for the training, supervision and monitoring of a school safety policy. The DoE must also encourage communities, non-governmental organizations, cultural organizations and business to support school safety initiatives and promote a safe learning environment. It is suggested that the police, parents and community leaders become involved in assisting schools to deal with violence. Teachers need to be re-skilled to deal with the issues of violence in schools and also to assist parents with good parenting skills. Although schools are affected by violence within the communities in which they are situated, both social and human capital within the schools' environments could be effectively used to buffer the effects of community violence. The DoE should ensure that a strict code of conduct should contain regulations outlining the rules that the school must ensure are included. The code of conduct must aim to establish a disciplined and purposeful school environment, dedicated to the improvement and maintenance of quality learning processes.

Quality assurance at schools should always be very careful that they are not adding unnecessary bureaucratic burdens when they are monitoring and that they can justify their requirements through some kind of evidence. They must also be alert to the various problems that can exist with different approaches to monitoring and improving educational quality in Mathematics. Teacher quality and its impact on learners' mathematical achievement have become global concerns and teachers' characteristics may affect learner' outcomes. There needs to be ways to support learners' mathematical learning effectively. The certification of high quality teachers must continually be a priority for policy makers, administrators and teacher trainers. Considering the call for high quality teachers, high stakes examinations and accountability, now more than ever teachers need to ensure that those who are certified are fully prepared in both content knowledge and dispositions to best teach according to the needs of learners.

Effective collaboration amongst professionals within the primary school and secondary school and other stakeholders to address the diverse needs of the learners and teachers can contribute significantly to the effective transition of learners into these phases. However, schools are not working collaboratively for the best possible solution to address barriers to learning. Collaboration requires purposeful engagement of both primary school and secondary school teaching parties and the importance of enlisting trained and willing learning support staffs who are motivated. There are increased instructional opportunities embedded in collaborative co-teaching. The possibilities of developing new teaching strategies within a collaborative co-teaching environment would raise the benefits to help learners. Teachers should form an inter-sectorial collaborating team with relevant stakeholders in primary and secondary schools to address barriers to learning in Mathematics and to provide support to learners, teachers and schools. Attention needs to be given to discontinuities in teaching approaches; the gap between learners’ expectations of secondary school and the reality; assisting teachers to develop strategies for helping learners manage their own learning; giving them the opportunity to ask questions on aspects they do not understand, particularly relating to classroom learning; and flexible learning/teaching, which takes account of differences in learners' preferred learning styles. It can also be argued that the impact of transition, pedagogy and teacher-learner relationships may have implications for different learners. A well-designed transition can maintain the strong sense of belonging that learners felt in primary school and which is also important if they are to continue to enjoy and succeed in academic tasks in Mathematics at secondary schools. To address these issues, bridging programs in Mathematics should be initiated between primary school and secondary school, as is done in some countries such as New Zealand and the United Kingdom. Intervention programs such as introduction to Mathematics should also be considered as an initiative to facilitate a smooth transition. Further collaboration between primary and secondary schools should be considered in order to bridge the gap during transition.

It is also recommended that future studies on a larger scale be conducted to improve quality Mathematics education at schools. Further research is envisioned in other educational districts to expand baseline information on the implementation of the Batho Pele principles at grassroots levels. However, more research is needed to establish the impact of such interventions and identify ways through which quality Mathematics teaching leads to better achievement gains. It has to be emphasized that research on this topic is critical as it is imperative for all researchers in this field to assist public servants on all levels of government in their journey on the road to "Batho Pele."

6.13 Conclusion

A fundamental starting point is to ensure that all learners have access to quality Mathematics education so that they acquire SKAVs in a curriculum that will establish what is needed for high standards of achievement, as well as for learners to be fully prepared for life and work beyond school. If the country is to achieve successful transitions from primary into secondary school and then into adulthood for all young

South Africans, it needs to focus on a school system that achieves high standards for all. To do this, government must ensure that the highest quality of teaching and learning is available in every school, and that there are targeted strategies in place to address and overcome the disadvantages that any child may bring to school. Governments, school systems and schools need to address this challenge by working together to ensure all learners are:

- ❖ achieving the essential skills they need in order to keep progressing through the CAPS curriculum in Mathematics;
- ❖ able to access a wider set of learning opportunities and community support in order to strengthen their engagement with learning; and
- ❖ able to make a successful transition from primary into secondary school.

All children need to master the basic Mathematics and learning skills that equip them to take advantage of what education can offer. This requires a universal focus on getting the basics right. There is a need to take an approach that combines high expectations of achievement with individually tailored learning opportunities. This does not preclude a focus on common targets for outcomes across all schools in South Africa. A strong focus on core skills, especially in Mathematics in the early years, is necessary to ensure that future learning is successful. To achieve this, school leaders need the autonomy and incentive to implement local approaches, such as specialized teachers who will embed high-quality teaching in Mathematics.

In light of the above discussion, it is clear that the current move is towards a more holistic and transformative approach when considering the issue of quality in Mathematics education. Teaching and learning need to be adapted to 21st century skills demands because Mathematics will prepare learners for non-routine and deep thinking tasks in the real world. South Africa has overcome institutionalized oppression and there should be no excuse for social policies that deny any learner the opportunity to decent quality education. It is crucial to confront these issues affecting the well-being and future potential of children in South Africa. It can also inform policy initiatives by helping to have a better understanding of what is working well and what needs improving in the dispensation of quality education. The potential exists to influence the shaping of educational policy and practices to more effectively prepare learners for the unique challenges of the 21st century.

On the other hand, Cheng (2003: 207), observes that despite the fact that stakeholders may be satisfied with educational services, if education does not cater for the future needs and challenges of the new millennium then it is still ineffective and “useless” for the new generation. It can be concluded that ability of the Mathematics curriculum to meet the needs of the future both at individual and societal level is one of the critical elements of quality in education. The findings demonstrate that for teachers to add more value in learners’ achievements, they should demonstrate much higher Mathematics proficiency. Based on evidence generated in this study, quality teaching constitutes effective education interventions for improving learning gains in Mathematics. The DoE, school managers, SGB, parents, local communities and learners need to recognize the critical role that teachers play in Mathematics education. They need to be acknowledged and respected by everybody concerned, particularly the DoE and higher education institutions. In light of this research, it would be prudent to examine and implement the recommendations and suggestions in this study for the implementation of SKAVs in CAPS and bridging the gap from primary to secondary phase Mathematics. To support this research a Model as illustrated in Figure 6.2, has been proposed to assist in bridging the gap between primary and secondary phase Mathematics.

In conclusion, the quality interface of Mathematics can improve if the following aspects are given due consideration:

- Ensure that there is strong and effective school management based on merit, which leads and entrenches quality education
- The appointment of credible and visionary leaders at all levels within the education sector
- Government needs to intervene to restore authority over public schools
- Conduct ongoing professional development of educators to enhance SKAVs
- Improve the quality of teaching and learning for excellence.

Figure 6.2: A proposed model for the quality interface between primary and secondary phase Mathematics

"Education is the most powerful weapon, which you can use to change the world."

Nelson Mandela (1918 – 2013)

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ANNEXURES

Annexure A: Ethical clearance from the KwaZulu-Natal Department of Education To conduct research

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma | Tel: 033 392 1004 | Ref.:2/4/8/751

Mrs S Moodley
25 Ramiah Drive
Metcalfe Park
Tongaat
4399

Dear Mrs Moodley

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"A STUDY OF THE QUALITY INTERFACE BETWEEN PRIMARY AND SECONDARY PHASE MATHEMATICS AT PUBLIC SCHOOLS IN MAFUKEZELA GANDHI CIRCUIT IN KWAZULU-NATAL"**, 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 31 March 2016 to 30 June 2017.
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 Office of the HOD, 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.

Pinetown District

[redacted]

Nkosinathi S.P. Sishi, PhD
Head of Department: Education
Date: 31 March 2016

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 beyond the call of duty
EMAIL ADDRESS: kehologile.connie@kzndoe.gov.za / Phindile.Duma@kzndoe.gov.za
CALL CENTRE: 0860 596 363; Fax: 033 392 1203 WEBSITE: WWW.kzneducation.gov.za

Annexure B: Letter of consent from the Durban University of Technology: Higher Degrees Ethics Committee to conduct research

DUT DURBAN UNIVERSITY OF TECHNOLOGY

FACULTY OF MANAGEMENT SCIENCES

28 February 2014

Reference: Proposal Approval: S Moodley, Student number 21243504

Dear Mrs Moodley

DOCTORATE DEGREE OF TECHNOLOGY: QUALITY

This serves to confirm the approval of your research proposal by the Faculty Research Committee, at its meeting on 25 October 2013, as follows:

1. Research proposal and provisional dissertation title:

   A STUDY OF THE QUALITY INTERFACE BETWEEN PRIMARY AND SECONDARY PHASE MATHEMATICS AT PUBLIC SCHOOLS IN THE MAFUKUZELA GANDHI CIRCUIT IN KWAZULU-NATAL

   Promoter: Prof P Singh

   Co-promoter: Prof R Sookrajh

   Please note that any proposed changes in the dissertation title require the approval of your supervisor/s, the Faculty Research Committee, as well as ratification thereof by the Higher Degrees Committee.

2. Research budget to the amount of **R15 000.00**

   Please note that this funding is not a scholarship or bursary and is therefore not paid directly to you, but is controlled by your supervisor. Any proposed changes to use of this funding allocation require the approval of your supervisor and the Faculty Research Committee.

The Institutional Research Committee has stipulated that:

(a) This University retains the ownership of any Intellectual Property (patent, design, etc.) registered in respect of the results of your Masters/Doctors Degree in Technology studies as a result of the award and the provisions of the above Act;

(b) Should you find any of the terms above not acceptable then you are given the option to decline the Research budget award to your project in writing.

May we remind you that in terms of Rule G25(2)(b), if you fail to obtain the Masters/Doctors degree within the maximum time period allowed after first registering for the qualification, Senate may refuse to renew your registration or may impose any conditions it deems fit. You may apply to the Faculty Research Committee for an extension.

Please note that you are required to convert your registration from the informal to the formal course and re-register each year.

Should you experience any problems relating to your research, your supervisor must be informed of the matter as soon as possible. If the difficulties persist, you should then approach your Head of Department and thereafter the Executive Dean of the Faculty.

Please refer to the 2014 General Rule Book concerning the rules relating to postgraduate studies, which include *inter alia* acceptable minimum and maximum timeframes, submission of thesis/dissertations, etc. You are also advised to read the Postgraduate Students' Guide which is available on the DUT website.

Please do not hesitate to contact this office for any assistance. We wish you success in your studies.

Kind regards,

[redacted]

FRC Chairperson: Faculty of Management Sciences

Cc Promoter: Prof P Singh

Annexure C: Consent to participate in the research

DUT DURBAN UNIVERSITY OF TECHNOLOGY

INSTITUTIONAL RESEARCH ETHICS COMMITTEE

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher,Savathrie Moodley about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _________,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

____________ ________ ________

Full Name of Participant **Date** **Time** **Signature / Right Thumbprint**

I, Savathrie Moodley herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

[redacted] 10-6-2013 [redacted]

Full Name of Researcher **Date** **Signature**

Full Name of Witness (If applicable) Date Signature

Full Name of Legal Guardian (If applicable) Date Signature

Annexure D: Letter of information

LETTER OF INFORMATION

Title of the Research Study:

A study of the quality interface between primary and secondary phase Mathematics at public schools in the Mafukezela Gandhi Circuit in KwaZulu-Natal

Principal Investigator/s/researcher:

Savathrie Moodley, Master in Education: Mathematics

Co-Investigator/s/supervisor/s:

Professor P. Singh, PhD

Professor R. Sookrajh, PhD

Brief Introduction and Purpose of the Study:

The aim of this study is to explore the quality interface between primary and secondary Mathematics education to determine the preparation of learners for the secondary phase. Quality has emerged as a necessity in education as we are faced with increasing competition and a demand for better quality of products and services. The ability to provide quality education is more than ever essential, there is at present a consensus for fundamental reforms in our education sector, with emphasis on Quality. At a time where sustainable development is being put forward as a prime objective for most governments around the world, it is recognised that education will have a critical role to play. The result of quality education is not about achieving high grades and mere academic excellence but the total development of the student. Service quality can be determined using the perspective of the customers 'outside-in' approach or the perspective of the service providers, in other words, the 'inside-out' perspective. In the inside-out approach, teachers and management may assume that they know the students' needs leading to poor performance in service quality because feedback from the students was not taken into consideration. A combination of the inside-out and outside-in approaches will be used in this study to evaluate the quality interface between primary and secondary phase Maths.

Outline of the Procedures:

The participant will be required to complete the questionnaire as honestly as possible. 18 schools will be used as venues for the questionnaires to be completed. A Letter of Information will be given to the educators and learners to inform them of the details and nature of the study so that they will be in a position to give written Informed Consent to participate in this study. The learners will be given the Letters of Informed Consent to take to their parents for signature, as they are minors. Should the students and teachers wish to participate in an interview, they need to complete the last section in the questionnaire that is detachable from the actual questionnaire to maintain anonymity. I will then contact them and arrange a suitable time to arrange for the interview. The purpose of the interview will be to obtain more information. The focus groups interview with the students will help to elicit a multiplicity of views and emotional processes within a group context.

Risks or Discomforts to the Participant

There is no risk or compulsion to the participants

Benefits:

The findings of this study will be made available through

- Publications in accredited peer-reviewed journals
- Presentation at local and international conferences
- Seminars and workshops on Mathematics Education
- Southern African Association for Research in Mathematics, Science and Technology Education (SAARMSTE) Proceedings

Reason/s why the Participant May Be Withdrawn from the Study:

The researcher will assure the learners that there will be no compulsion for them to participate in the study and that they should not fear reprisal from anyone if they chose not to participate or if they withdraw from the study at any time. There will be no adverse consequences for participants.

Remuneration:

Participants will not receive any type of remuneration.

Costs of the Study:

Participants will not incur any costs.

Confidentiality

Participants will be assured of anonymity and they will be informed that all data and their details will be kept confidential.Anonymity of all participants is guaranteed, as they will only be identified by codes. Recorded interviews will be confidential. The data collected through the interviews and questionnaire will be locked in a steel locker and will only be available to the researcher and the supervisors until such time it can be discarded in a manner that all participants' confidentiality is upheld. The questionnaires will be shredded after 15 years thus maintaining total confidentiality.

Research-related Injury:

Participants will only be completing a questionnaire in a school environment for about 15 minutes. Those who volunteer will be interviewed at school. There should not be any research-related injury or adverse reaction as the study is non-evasive hence there should be no need for compensation.

Persons to Contact in the Event of Any Problems or Queries:

Researcher: Savathrie Moodley (contact number 072276035 or e-mail:savymoodley@yahoo.com. Supervisor: Professor P. Singh. Research co-ordinator: Faculty of Management Sciences. Please contact the researcher 0722760350 my supervisor 031 3735599 or the Institutional Research Ethics administrator on 031 373 2900. Complaints can be reported to the DVC: TIP, Prof F. Otieno on 031 373 2382 or dvctip@dut.ac.za.

General:

Participation is voluntary and the approximate number of participants to be included in this study is 737. You may withdraw from this study at any time without any negatiive consequences by advising the researcher. I want to assure you that this study has been reviewed and received ethics clearance from the Institutional Research Ethics Committee (IREC). However, the final decision regarding participation is yours. If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me on 072276035 or e-mail atsavymoodley@yahoo.com. You can also contact my supervisor, Professor Penny Singh on 031 3735599 or e-mail her at pennysin@dut.ac.za.A copy of the information letter would be issued to you.

Annexure E: Questionnaire to secondary school Mathematics teachers

PROPOSED TEACHER QUESTIONNAIRE: Secondary School

Dear Sir/Mam

Thank you for participating in this survey. This questionnaire pertains to the quality of service you receive from the Department of Education to support you in your teaching. This questionnaire consists of 3 sections.
Section A: There are 4 questions pertaining to you.
Section B: This section consists of 15 questions based on a slightly amended SERVQUAL instrument and relates to the support in terms of expectations and perceptions of the service received. There are four open-ended questions allowing you for further comments.
Section C: This section consists of 8 questions based on your learners
Section D: This is an optional section for those participants who wish to participate in an interview.
Please Note: Please complete this questionnaire as accurately as possible. All data collected in this survey will be treated with the utmost confidence and it will be used solely for the purpose of the study.

SECTION A: ABOUT YOU

(Please tick (√) in the appropriate box)

1. Teaching status

Permanent	Temporary (UTE)	Governing Body Appointed

2. Gender

Female	Male

4. Highest Qualification in Mathematics

Secondary school	
Diploma	
Degree	
Post graduate degree	

3. Grades you are currently teaching Mathematics

8	9	10	11	12

SECTION B: PROFESSIONAL DEVELOPMENT

For each of the following statements, please indicate the level of service quality provided by the Department of Education. Please rate the service by placing a tick in the appropriate box on the 5 point Likert scale, that reflects your feeling regarding your expected service (what kind of service you expect to receive) and perceived service (what is your opinion/perception of the quality of the service you actually receive) in terms of service delivery. This section also contains four open-ended questions. **KEY**

1- strongly disagree ***2- disagree*** ***3. Neutral***

4- agree ***5- strongly agree***

Please make any additional comments/suggestions where applicable. **PLEASE NOTE:** There are no incorrect answers

PROFESSIONAL DEVELOPMENT AND SUPPORT

No.	**Statement**		**1**	**2**	**3**	**4**	**5**
1	The Maths department at the DoE is committed to good service	Expected Service					
		Perceived Service					
Further Comment:							

No.	**Statement**		**1**	**2**	**3**	**4**	**5**
2	I receive adequate support from the Maths Department at DoE to perform my tasks efficiently and effectively	Expected Service					
		Perceived Service					
Further Comment:							

No.	**Statement**		**1**	**2**	**3**	**4**	**5**
3	The Maths department’s employees are enthusiastic when providing the required Maths service	Expected Service					
		Perceived Service					
Further Comment:							

No.	**Statement**		**1**	**2**	**3**	**4**	**5**
4	The Maths department’s employees provide the required Maths service in a professional manner.	Expected Service					
		Perceived Service					
Further Comment:							

No.	**Statement**		**1**	**2**	**3**	**4**	**5**
5	The Maths department’s employees respond to e- mails/ telephone calls timeously	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
6	The Maths department's employees have up to date resources which are easily obtainable	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
7	The Maths department's employees are always presentable and well-mannered when providing the required Maths service	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
8	The Maths department's employees are suitably qualified in their area of expertise which enables them to deliver quality Maths support.	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
9	The Maths department's employees provide significant professional development workshops to develop Maths teachers?	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
10	The Maths department's employees are polite, courteous and helpful.	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
11	The Maths department's employees are very knowledgeable and confident regarding their respective areas in Maths	Expected Service					
		Perceived Service					
Further Comment:							

ASSURANCE: KNOWLEDGE, COURTESY AND ABILITY TO CONVEY TRUST AND CONFIDENCE

No.	Statement		1	2	3	4	5
12	Learners expect me to be confident and knowledgeable in Maths	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
13	My learners trust that they will always receive support in Maths	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
14	My learners expect me to be courteous and polite irrespective of the circumstances	Expected Service					
		Perceived Service					
Further Comment:							

EMPATHY: PROVIDING CARING INDIVIDUALISED SUPPORT TO YOUR LEARNERS

No.	Statement		1	2	3	4	5
15	My learners expect me to show empathy and reassurance when they experience problems in maths	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
16	I have a friendly disposition with the learners	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
17	My learners are happy with my teaching.	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
18	My learners expect me to have their best interest at heart.	Expected Service					
		Perceived Service					
Further Comment:							

SECTION C: OPEN-ENDED QUESTIONS

1. Do you perceive a gap between primary and secondary school Maths? ________________
Give an explanation your
response____
____
____
__________________________________ 2. In your opinion are the learners who come from primary school adequately prepared for secondary school Maths? ______________________
Comment:
____
____

3. What may be the factors that may contribute to a gap between the primary and secondary phase.
____
__________________________________ 4. Do learners grasp concepts taught in Maths easily?
____

Comment
____
____

5. Do learners perform better in algebra and substantially worse in geometry/ ____________________
Comment:
____
____

6. What factors may possibly contribute to the difficulties experienced in teaching Maths at the secondary school?
____
____
____

SECTION D: INTERVIEW (This section is optional)

Will you be interested in participating in an interview? (Please tick (√) in the appropriate box)

YES	NO

CELL NO. ________________________________

Thank you for your time taken in completing this questionnaire
S.Moodley

Annexure F: Questionnaire to secondary school learners

QUESTIONNAIRE (Secondary School Learners)

SECTION A: ABOUT YOU

1. What grade are you in? __________________

2. What is your age? ____________________

3. What is your home language? __________________

Please tick (√) in the appropriate box

4. What is your gender?

Female	
Male	

5. Did you enjoy Maths in primary school?

YES		**NO**	

6. Do you enjoy Maths in secondary school?

YES		**NO**	

SECTION B: ABOUT YOUR PRIMARY SCHOOL MATHS

Reasons why secondary school learners like Maths in primary school

	YES	NO
Good/encouraging teachers in primary school		
We did activities/games in Maths in primary school		
Maths was enjoyable/interesting in primary school		
It was easier in primary school		
Primary school developed my mathematical knowledge and skills sufficiently for secondary school		

Reasons why secondary school learners did not like Maths in primary school

	YES	NO
Maths was boring in primary school		
Poor teaching in primary school		
It was hard, I found Maths hard in primary school		

General

I think I will be successful in a career that requires mathematical ability?	**YES**		**NO**	

SECTION C: Personal Confidence in Maths

Please tick (√) in the appropriate box. Do not tick more than one box. There are no correct or incorrect answers.

Statements	**A Strongly Agree**	**B Agree**	**C Not Sure**	**D Disagree**	**E Strongly Disagree**
1. I am good at Maths					
2. I do not enjoy Maths					
3. Primary school Maths was not challenging					
4. Maths that I learnt in primary school does not help in the secondary school					
5. Maths that I learn in secondary school is different from the Maths I learnt at primary school					
6. I find Maths too difficult for me					
7. I am confident of myself when I do Maths					
8. Maths is dull and boring.					
9. My teacher makes me feel that Maths is useful in everyday life.					
10. I rarely use the Maths I learn at school in everyday life					
11. Overall I find the Maths lessons at school interesting.					
12. Learning Maths is too stressful.					
13. I would avoid studying Maths after matric					
14. My teacher thinks that I can do well in Maths.					
15. Maths is my worst subject					

Please describe what your perception/ opinion is of any expectations about Maths in terms of support and subject matter.

____

____

SECTION D : MY MATHS TEACHER

For each of the following statements, please indicate the service quality provided by your Maths teacher
Please make any additional comments/suggestions where applicable
PLEASE NOTE: There are no incorrect answers

No.	**Statement**		***agree***	***disagree***
1	My Maths teacher is polite, courteous and kind	What I expect?		
		What I experience?		

No.	**Statement**		***agree***	***disagree***
2	My Maths teacher is knowledgeable and confident in Maths	What I expect?		
		What I experience?		

No.	**Statement**		***agree***	***disagree***
3	My Maths teacher is helpful when I ask for help	What I expect?		
		What I experience?		

No.	**Statement**		***agree***	***disagree***
4	My Maths teacher is enthusiastic and encourages us in class	What I expect?		
		What I experience?		

No.	**Statement**		***agree***	***disagree***
5	My Maths teacher explains the lessons and I understand	What I expect?		
		What I experience?		

No.	**Statement**		***agree***	***disagree***
6	My test papers are marked timeously and my teacher reviews the test	What I expect?		
		What I experience?		

SECTION E: INTERVIEW (This section is optional)

Will you be interested in participating in an interview? (Please tick (√) in the appropriate box)

YES		**NO**	

GRADE: ________________________

Thank you for your time ☺

Annexure G: Questionnaire to primary school Mathematics teachers

PROPOSED TEACHER QUESTIONNAIRE: Primary School

Dear Sir/Mam

Thank you for participating in this survey. This questionnaire pertains to the quality of service you receive from the Department of Education to support you in your teaching. This questionnaire consists of 3 sections.
Section A : There are 4 questions pertaining to you.
Section B : This section consists of 15 questions based on a slightly amended SERVQUAL instrument and relates to the support in terms of expectations and perceptions of the service received. There are four open-ended questions allowing you for further comments.

Section C: This section consists of 8 questions based on your learners
Section D : This is an optional section for those participants who wish to participate in an interview.
Please Note: Please complete this questionnaire as accurately as possible. All data collected in this survey will be treated with the utmost confidence and it will be used solely for the purpose of the study.

SECTION A: ABOUT YOU

(Please tick (√) in the appropriate box)

1. Teaching status

Permanent	Temporary (UTE)	Governing Body Appointed

2. Gender :

Female	
Male	

3. Grades you are currently teaching Maths

4	5	6	7

4.Highest Qualification in Mathematics

Secondary school	
Diploma	
Degree	
Post graduate degree	

SECTION B: PROFESSIONAL DEVELOPMENT

For each of the following statements, please indicate the level of service quality provided by the Department of Education. Please rate the service by placing a tick in the appropriate box on the 5 point Likert scale, that reflects your feeling regarding your expected service (what kind of service you expect to receive) and perceived service (what is your opinion/perception of the quality of the service you actually receive) in terms of service delivery. This section also contains four open-ended questions. **KEY**

1- strongly disagree ***2- disagree*** ***3. Neutral***

4- agree ***5- strongly agree***

Please make any additional comments/suggestions where applicable. **PLEASE NOTE:** There are no incorrect answers

PROFESSIONAL DEVELOPMENT AND SUPPORT

No.	**Statement**		**1**	**2**	**3**	**4**	**5**
1	The Maths department at the DoE is committed to good service	Expected Service					
		Perceived Service					
Further Comment:							

No.	**Statement**		**1**	**2**	**3**	**4**	**5**
2	I receive adequate support from the Maths Department at DoE to perform my tasks efficiently and effectively	Expected Service					
		Perceived Service					
Further Comment:							

No.	**Statement**		**1**	**2**	**3**	**4**	**5**
3	The Maths department's employees are enthusiastic when providing the required Maths service	Expected Service					
		Perceived Service					
Further Comment:							

No.	**Statement**		**1**	**2**	**3**	**4**	**5**
4	The Maths department's employees provide the required Maths service in a professional manner.	Expected Service					
		Perceived Service					
Further Comment:							

No.	**Statement**		**1**	**2**	**3**	**4**	**5**
5	The Maths department's employees respond to e- mails/ telephone calls timeously	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
6	The Maths department's employees have up to date resources which are easily obtainable	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
7	The Maths department's employees are always presentable and well-mannered when providing the required Maths service	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
8	The Maths department's employees are suitably qualified in their area of expertise which enables them to deliver quality Maths support.	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
9	The Maths department's employees provide significant professional development workshops to develop Maths teachers?	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
10	The Maths department's employees are polite, courteous and helpful.	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
11	The Maths department's employees are very knowledgeable and confident regarding their respective areas in Maths	Expected Service					
		Perceived Service					
Further Comment:							

ASSURANCE: KNOWLEDGE, COURTESY AND ABILITY TO CONVEY TRUST AND CONFIDENCE

No.	Statement		1	2	3	4	5
12	Learners expect me to be confident and knowledgeable in Maths	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
13	My learners trust that they will always receive support in Maths	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
14	My learners expect me to be courteous and polite irrespective of the circumstances	Expected Service					
		Perceived Service					
Further Comment:							

EMPATHY: PROVIDING CARING INDIVIDUALISED SUPPORT TO YOUR LEARNERS

No.	Statement		1	2	3	4	5
15	My learners expect me to show empathy and reassurance when they experience problems in maths	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
16	I have a friendly disposition with the learners	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
17	My learners are happy with my teaching.	Expected Service					
		Perceived Service					
Further Comment:							

No.	Statement		1	2	3	4	5
18	My learners expect me to have their best interest at heart.	Expected Service					
		Perceived Service					
Further Comment:							

SECTION C: OPEN-ENDED QUESTIONS

1. Do you perceive a gap between primary and secondary school Maths? ________________
Give an explanation your
response____
____
____

2. In your opinion are the learners who come from primary school adequately prepared for secondary school Maths? ______________________
Comment:
____
____

3. What may be the factors that may contribute to a gap between the primary and secondary phase.
____
____

4. Do learners grasp concepts taught in Maths easily? _________________________
Comment
____
____

5. Do learners perform better in algebra and substantially worse in geometry/ ____________________
Comment:
____
____

6. What factors may possibly contribute to the difficulties experienced in teaching Maths at the secondary school?
____
____
____

SECTION D: INTERVIEW (This section is optional)

Will you be interested in participating in an interview? (Please tick (√) in the appropriate box)

YES		**NO**	

CELL NO. ________________________________

Thank you for your time taken in completing this questionnaire
S.Moodley

Annexure H: Questionnaire to primary school learners

QUESTIONNAIRE (Primary School Learners)

SECTION A: ABOUT YOU

1. What is your home language? __________________

2. What is your age? ____________________

(Please tick (√) in the appropriate box)

3. What is your gender?

Female	
Male	

4. Do you enjoy Maths?

YES	NO

SECTION B: Student Self- and Task- Related Beliefs in Maths

(Please tick (√) in the appropriate box in either 1 or 2)

Nos.	Statements	1		2	
1	How well do you think you will do in Math this year?	**Not well**		**Well**	
2	How successful do you think you'd be in a career that required mathematical ability?	**Not successful**		**Successful**	
3	When taking a Maths test I have studied for, I do	**Poor**		**Well**	
4	How have you been doing in Maths this year?	**Poor**		**Well**	
5	In general, how is Maths for you?	**Difficult**		**Easy**	
6	Compared to most other school subjects you have taken, how is Maths for you?	**Hardest**		**Easiest**	

SECTION C: Personal Confidence in Maths

Please tick (√) in the appropriate box. Do not tick more than one box. There are no correct or incorrect answers.

Statements	**A Strongly Agree**	**B Agree**	**C Not Sure**	**D Disagree**	**E Strongly Disagree**
1. I am good at Maths					
2. I do not enjoy Maths					
3. Maths will help me in my career.					
4. I will use Maths in many ways as an adult.					
5. Maths is important in everyday life.					
6. I find Maths too difficult for me					
7. I am confident of myself when I do Maths					
8. Maths is dull and boring.					
9. My teacher makes me feel that Maths is useful in everyday life.					
10. I rarely use the Maths I learn at school in everyday life					
11. Overall I find the Maths lessons at school interesting.					
12. Learning Maths is too stressful.					
13. I would avoid studying Maths after matric					
14. My teacher thinks that I can do well in Maths.					
15. Maths is my worst subject					

Home Language: **IsiZulu** _________ **English** __________

1. Do you understand the language well enough in Mathematics?

YES	**NO**

2. Do you understand the concepts/ terminologies in Mathematics?

YES	**NO**

3. What are some of the problems you experience in Mathematics?

SECTION D: MY MATHS TEACHER

For each of the following statements, please indicate the service quality provided by your Maths teacher
Please make any additional comments/suggestions where applicable
PLEASE NOTE: There are no incorrect answers

No.	**Statement**		***agree***	***disagree***
1	My Maths teacher is polite, courteous and kind	What I expect?		
		What I experience?		

No.	**Statement**		***agree***	***disagree***
2	My Maths teacher is knowledgeable and confident in Maths	What I expect?		
		What I experience?		

No.	**Statement**		***agree***	***disagree***
3	My Maths teacher is helpful when I ask for help	What I expect?		
		What I experience?		

No.	**Statement**		***agree***	***disagree***
4	My Maths teacher is enthusiastic and encourages us in class	What I expect?		
		What I experience?		

No.	**Statement**		***agree***	***disagree***
5	My Maths teacher explains the lessons and I understand	What I expect?		
		What I experience?		

No.	**Statement**		***agree***	***disagree***
6	My test papers are marked timeously and my teacher reviews the test	What I expect?		
		What I experience?		

Thank you for your time ☺