

**THE EFFECT OF COLLECTIVE EFFICACY ON THE
INTRODUCTION OF A NEW CURRICULLUM BY
MATHEMATICS TEACHERS**

By

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PROMOTER: PROFESSOR M.M. BOTHA

DECLARATION

I, *Winston Willie Hendricks*, student number 202345297, hereby declare that the thesis for the degree of *Philosophiae Doctor Educationis* is my own work and that it has not previously been submitted for assessment or completion of any postgraduate qualification to another university or for another qualification.

Signed:



Winston Willie Hendricks

Date: Friday, 22 February, 2013

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DEDICATION

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ACRONYMS

ANA	Annual National Assessment
ANC	African National Congress
C2005	Curriculum 2005
CAPS	Curriculum and Assessment Policy
CE	Collective Efficacy
CLES	Constructivist Learning Environment Survey
DBE	Department of Basic Education
DOE	National Department of Education
ELRC	Education Labour Relations Council
FET	Further Education and Training
GET	General Education and Training
HSRC	Human Science Research Council
LO	Learning Outcome
LTSM	Learning and Teaching Support Material
MP	Member of Parliament
NATED 550	National Assembly Training and Education 550
NCS	National Curriculum Statement
NCSM	National Curriculum Statement for Mathematics
NQF	National Qualifications Framework
OBE	Outcomes-based Education
PIRLS	Progress in the International Reading and Literacy Study
RNCS	Revised National Curriculum Statement
SMT	School Management Team
TIMSS	Third International Mathematics and Science Study
TSE	Teacher Self-Efficacy
UNICEF	United Nations Children Fund

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SUMMARY

The introduction of curriculum changes in mathematics has brought about challenges for both mathematics teachers and learners in South African schools. Apart from introducing new curriculum content to learners, teachers cope with factors which impact upon their collective efficacy (the sum total of the self-perceptions of all the teachers in a particular school regarding the conduciveness of effective teaching, learning and assessment processes) and on the teacher self-efficacy of mathematics teachers (the personal self-perceptions of mathematics teachers to execute their mandates effectively in the teaching, learning and assessment of mathematics) which consequently lead to mathematics learners developing better concepts in mathematics.

This study focuses on the impact of collective efficacy on the implementation of the *New Curriculum Statement (NCS)* for mathematics teachers, teaching in schools situated in previously disadvantaged communities. It is within the context of the constraints that these schools face, not only the socio-economic barriers, but also the willingness of all the teachers to develop a culture of teaching and learning, and the consequent impact it has on the effective teaching, learning and assessment of mathematics in the classrooms of these schools, that the effect of efficacious/non-efficacious teachers in these schools is investigated.

A mixed method approach by using quantitative data (generated from questionnaires) and qualitative data (generated from interviews) probe the primary research question, which aims to investigate the effect of collective efficacy on the introduction of a new curriculum by mathematics teachers. The sub-questions probe the specific efficacy relations relating to the primary research question in terms of the perceptions and perspectives of all the teachers about their respective sample schools, how these perceptions and perspectives influence mathematics teachers in the manner they perceive their control over the teaching, learning and assessment processes in the mathematics classroom, and the consequent impact it has on mathematics learners developing better concepts and ultimately achieving better academic results in mathematics.

Keywords: collective efficacy, self-perceptions, conduciveness, new curriculum statement, constraints, socio-economic, willingness, efficacious, mixed method, concepts

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

The introduction of the new curriculum statement in South Africa, according to the National Department of Education (DOE), has brought about curriculum change that has been stimulated by political transition in all spheres of community life, with its focus on implementing values and principles of our new democratic society (DOE, 2003a:7).

The changes envisaged in the new curriculum statement aim to introduce an education system that is learner-centred, activity-based and has an outcomes approach to teaching and learning (DOE, 2003a:7). Wrigley (2003:43) calls for a more critical approach to the purposes of education in which it states "... a new direction for improvement, one which is not so dependent, which can focus on social justice and responsibility and global citizenship, which is future orientated and genuinely transformational".

The study of collective efficacy on mathematics and non-mathematics teachers is important within the context of a changing curriculum for all learning areas in South African schools, which requires from teachers to use a range of learner-centred

methodologies, use co-operative methods of learning which facilitate conceptual and relational understanding rather than rote or procedural knowledge.

The dynamic and complex role played by all the teachers, who teach in schools situated at previously disadvantaged communities in East London in Eastern Cape, and who introduce curriculum changes in mathematics, is central to this study. Solomon (2007:50) provides a more extensive definition of *collective efficacy* as the collective self-perception that teachers at a particular school have to make an educational difference to their learners over and above that of their homes and communities.

The context, within which the learners understand curriculum content in their respective learning environments, considering social, political and economic disparities, forms an integral part of how collective efficacy effects curriculum implementation by mathematics teachers.

The participants, namely all the teachers as well as grade twelve mathematics learners from the sample schools, form an integral part of this research. This chapter finally deals with the ethical considerations of these participants, of which ethical aspects such as confidentiality, the right to privacy and anonymity amongst others, is assured by the researcher.

1.2 STATEMENT OF THE PROBLEM

The challenges brought about by the curriculum changes in mathematics shifts its focus from an *instrumentalist view* developing abstract mathematical knowledge by mastering mathematical skills and algorithms to a *problem-solving view* developing mathematical meaning to knowledge which is flexible, transferable and applicable to everyday life and other learning areas (Webb & Glover, 2004:73).

It is not without resistance that teacher-directed pedagogies will just be replaced by a new learner-centred curriculum in South African schools. Walls (2004:1) describes how shifting expectations of what constitutes effective mathematics have produced an opposition between transmission (old) and discovery (new) conceptions of teaching mathematics, creating conflict for teachers between two seemingly distinct models.

It is within the context of these distinct models, coupled with many constraints in the educational setting of previously disadvantaged schools such as overcrowding, lack of textbooks, no functional laboratories or libraries etc., that the introduction of the curriculum changes is investigated. According to the DOE (2003a:13), these constraints act as barriers to learning within the educational setting for both teachers and learners. Examples of these barriers of learning mentioned (DOE, 2003a:14), include systematic barriers (access to basic services, poor teaching, lack of basic and appropriate learning and teacher support, overcrowded classrooms etc.), societal barriers (poverty, urban/rural disparities, discrimination on the basis of race, gender, language, disabilities etc.), pedagogical barriers (insufficient support of teachers, inappropriate attitudes etc.) as well

as factors that emerge from learners because of disabilities e.g. physical, cognitive and other conditions (disease, chronic illness, trauma etc.).

A newspaper article *SA needs maths and science help* (Daily Dispatch 2007, October 29), reports on an intervention for mathematics and science teaching. It is reported in this article that only 3 out of 1000 teachers in South Africa could significantly contribute to effective mathematics education as compared to 71 in Japan and 22 in the United States of America. A spokesman for University of Johannesburg, Herman Esterhuizen, mentioned in the same article that South African mathematics and science teachers are often criticized, and that 1433 foreign educators are currently teaching these subjects in South African schools to ease the crisis.

The introduction of curriculum changes in the South African context brings along some unique challenges. The poor performance of South African grade 8 learners in mathematics and science as compared to international benchmarks is well documented (TIMSS, 2003:56). The fact that even South African grade 12 learners performed so poorly in the Third International Mathematics and Science Study (TIMSS), suggests that their general mathematics and science skills are limited, and fall short of the literacy levels necessary for effective functioning in society (Moodaley, Grobler & Lens, 2006:635). The then National Minister of Education, Naledi Pandor MP (DOE, 2007a:2) referred to the release of the 2007 senior certificate examination results, when she stated with some alarm the inadequate progress in the higher grade passes in mathematics and science. Pandor (DOE, 2007a:2) also mentioned that the Dinaledi (under-performing)

schools must be given focused attention and support by every province, as must be the priority of ensuring that every child studying mathematics and science has a qualified and competent teacher in their respective classrooms.

The introduction of the Annual National Assessment (ANA) in 2011, is to continuously measure, at the primary school level, the performance of individual learners and that of classes, schools, districts, provinces and the country as a whole (Motshekga, 2011b:2). The results of the tests that were written February 2011, according to Motshekga (2011b:2), show that the national average performance for Grade 3 in Literacy stands at 35% and for Numeracy learners are performing at an average of 28%. The report also states that the provincial performance in Literacy and Numeracy is between 19% in Mpumalanga, the lowest and 43% in the Western Cape, the highest. In the case of the different levels of performance, according to Motshekga (2011b:2), in Grade 3, 47% of learners achieved above 35% in Literacy, and 34% of learners achieved above 35% in numeracy.

In Grade 6, according to the national average, performance in Languages is 28% and for Mathematics the average performance is 30% (Motshekga, 2011b:2). The Provincial performance in Languages and Mathematics ranges between 20% in Mpumalanga, the lowest and 41% in the Western Cape, the highest. In terms of the different levels for Grade 6, 30% of learners achieved above 35% in Languages, and 31% of learners achieved above 35% in Mathematics.

The comparison of a mathematics and science curriculum being taught in developed countries such as Britain and Australia measured against developing countries such as South Africa, contextualizes the challenges that exist in the South African education system. The curriculum changes, according to Asmal (DOE, 2003a:viii), will be differently interpreted and enacted in diverse contexts, which therefore makes the availability of resources for teaching and learning an asset in any educational setting.

It is within the context of the *unavailability* of these resources in previously disadvantaged schools, that the introduction of curriculum changes is researched. The lack of well equipped laboratories and/or libraries (without computer and multi-media facilities), physical constraints (heavy teaching workloads, overcrowded classrooms, lack of teacher and learner support material) and psychological constraints (low morale, a negative stigmatizing of the teaching profession, disempowerment of teacher control by a human rights and democratic learning culture) are major challenges for teachers and learners in previously disadvantaged schools and who are faced with new reforms in the curriculum.

The effect that collective efficacy has on mathematics teachers, who have to introduce curriculum changes in previously disadvantaged schools, is contextualized by Woolfolk Hoy (2004:3) in that “students’ sense of efficacy affects their motivation and learning while teachers’ motivation and learning are affected both by their own sense of efficacy and collective efficacy of other teachers in the school”. Mawhinney, Haas and Wood (2005:4) state that collective efficacy is a cultural property of schools that reflects

a collective set of beliefs that have a differential effect on student achievement. Perceived collective efficacy is a construct derived from social cognitive theory that is based on the assumption that “the choices that individuals and organizations (through the actions of individuals) make are influenced by the strength of their efficacy beliefs” (Goddard, Hoy & Woolfolk Hoy, 2004:4). It is therefore through the choices that learners make, influenced by the collective efficacy beliefs of the education setting, which impact either positively or negatively on their academic achievement.

Learner attainment, which is defined as the academic achievement of learners, is an important outcome in all learning processes, especially in mathematics. However, the importance of mathematics within the context of changes within the mathematics curriculum cannot be understated, not only because it should be taught in context and be relevant to career choices, but also because it serves as a tool in the current technological age. Motshekga (2011b:1) mentions that it is unacceptable for a nation whose democratic promise, which includes education and skills development in a global world, places a premium on its ability to work skillfully with words, images and numbers. Thomas and Brown (2009:1) also suggest that educational needs of the twenty-first century pose fundamental challenges for educators and educational practice, and that the transfer of static knowledge simply cannot keep up with the “rapid change” that characterizes the prevailing context.

Bringing efficacious teachers and learners to the educational setting is an important step forward to ensure that teaching and learning outcomes in mathematics do

materialize. Efficacious teachers and learners also require an understanding about effective approaches to teaching, learning and assessment to ensure the effective implementation of curriculum changes in their respective schools.

The implementation of the new curriculum reforms in mathematics is not only a challenge regarding new content, new teaching strategies, new learning strategies and new assessment strategies, but also a challenge in terms of self-belief orientations from mathematics teachers that the changes in the curriculum are teachable, even under adverse socio-economic conditions. The research problem is therefore a consequence of the challenges faced by teachers and learners in previously disadvantaged schools trying to implement a first world curriculum in a third world classroom.

Collective efficacy is therefore an important determinant in educational institutions to consider when teaching and learning effectiveness is measured, which consequently leads to the academic achievement or under-achievement of mathematics learners.

1.3 RESEARCH QUESTIONS AND SUB-QUESTIONS

The primary question of this study is:

To what extent does collective efficacy affect mathematics teachers implementing curriculum changes in mathematics, who teach in secondary schools situated in previously disadvantaged communities?

The sub-ordinate questions in the study are:

- To what extent does collective efficacy affect the perceptions and perspectives of all teachers, both mathematics teachers and non-mathematics teachers, that the curriculum changes could be implemented effectively?
- To what extent does collective efficacy affect the management of these curriculum changes which includes the effectiveness of teaching, learning and assessment strategies in mathematics, which mathematics teachers are implementing?
- To what extent does mathematics efficacy affect mathematics teachers and learners in terms of effective teaching and learning methods, which leads to a better conceptual understanding of mathematics, and consequently to better academic achievement by learners?

1.4 RESEARCH AIM AND RESEARCH OBJECTIVES

1.4.1 Research Aim

The main aim of this research is to investigate the effect of collective efficacy on mathematics teachers trying to implement changes in the mathematics curriculum in secondary schools situated in previously disadvantaged communities.

1.4.2 Research Objectives

The objectives of the research are to establish to what extent does collective efficacy affect the perceptions and perspectives of all teachers, that the changes in the mathematics curriculum could be implemented effectively, taking the socio-economic conditions into consideration where these schools are located.

The study also assesses to what extent collective efficacy affects the management (teaching, learning and assessment strategies) of the mathematics curriculum which mathematics teachers implement, taking into consideration the effective approaches to curriculum management and curriculum delivery.

Another important objective of this research is to establish to what extent collective efficacy affects teaching and learning effectiveness by teachers and learners in classroom practice, hence ensuring that learners achieve their maximum potential in mathematics.

The research culminates in how collective efficacy impacts upon mathematics teachers and learners, and consequently whether that efficacy relationship translates into how reformed curriculum content is understood by learners, who are faced with different constraints in their respective learning environments.

1.5 LITERATURE REVIEW

The literature review for this study will mainly focus on two main themes, namely: *collective efficacy* and *implementation of curriculum changes* in mathematics over time. The curriculum changes for mathematics are envisaged to be implemented in South African classrooms with an effective approach to teaching, learning and assessment, hence putting the learner in the centre of the education process.

The literature review for this study will furthermore be guided by the effect that collective efficacy has on the role of mathematics teachers in a transition period from a behaviourist to a constructivist approach of teaching and learning in the mathematics classrooms, investigate the efficacy relationship between the *new* teacher and the learners, and how collective efficacy relations impact upon academic achievement of changing curriculum content, considering the challenges that exist in previously disadvantaged schools.

The frame of reference for this research on the impact of collective efficacy on curriculum change in previously disadvantaged schools, is defined in terms of Rotter's (1966:243-250) locus of control theory or Rotter's social learning theory, where teachers have to concur on whether the environment overwhelms a teacher's ability to have an impact on a student's learning, a belief that reinforcement of their teaching efforts lies outside their control or is *external*, or whether teachers express confidence in their ability to teach difficult or unmotivated students, a belief that reinforcement of teaching efforts lies within the teachers' control or is *internal*.

1.5.1 Collective efficacy

McGuigan (2005:43) cited that Bandura (1993) was the first person to explore the link between collective efficacy and academic achievement. Bandura (1993:141) asked teachers about their beliefs “in their school’s capability as whole”, and found that teachers’ beliefs in the collective ability of the staff to teach the school’s learners were associated with the school’s aggregate academic performance, and that these effects were stronger than the effects of socio-economic status or prior academic achievement.

Goddard, Hoy and Woolfolk Hoy (2004:8) found that “perceptions of collective efficacy directly affect the diligence and resolve with which groups choose to pursue their goals”. Hoy and Miskel (2005:179) point out that research shows a “strong school culture of efficacy seems to promote high student achievement, in part, because it leads to the acceptance of challenging goals, strong organizational effort, and persistence that leads to better performance.”

Previous research by McGuigan (2005) found that collective teacher efficacy, trust of subject departments in learners and parents, and academic emphasis are school characteristics that have been found to be associated with academic achievement, even when controlling for socio-economic status. While socio-economic factors continue to show a strong association with learner achievement, other factors within the control of schools also appear to be more important. Numerous studies (Goddard, LoGerfo & Hoy, 2004; Hoy, Sweetland & Smith, 2002) have shown that the beliefs of teachers about their ability to successfully teach the learners in their school significantly impact learner

achievement, reducing the effect of socio-economic status. Hoy, Tarter and Hoy (2006) suggested three characteristics of schools (socio-economic status, teachers' beliefs and climate of the school), were all highly associated with academic achievement and were related.

In the past, most research in mathematics education focused on learner academic achievement, without studying the learning environment as a determinant of learning outcomes (Hoang, 2008:49). This study (Hoang, 2008:57) concluded strong evidence of association between students' attitudes and their learning environment. This study is significant, because it provides information about how learners from different grade levels, ethnicities and gender perceive their mathematics classroom environment and what attitudes they have toward mathematics. Few studies in the field of learning environments have been conducted in South Africa (Aldridge, Fraser & Ntuli, 2009:3). The research by Aldridge *et al.*(2009) provided the first learning environmental study at primary school level in South Africa and supported the use of positive learning environments to improve teaching and learning. Some studies (Aldridge, Fraser & Sebela, 2004); Aldridge, Laugksch & Fraser, 2006; Aldridge, Laugksch, Seopa & Fraser) were carried out at high school level and one at tertiary level (Adams, 1997), and yielded the same results.

Jerald (2007:2) highlighted how teacher perceptions of individual and collective efficacy indirectly influence student learning. The report notes that previous research has shown that teachers with strong perceptions of efficacy put more effort into planning

lessons, are more open to new ideas, and persevere in the face of new challenges. Brinson and Steiner (2007:2) define *collective teacher efficacy* as “the perceptions of teachers that the efforts of the subject department as a whole will have a positive effect on students.” Teachers with stronger perceptions of collective efficacy are more likely to say they agree with statements “teachers in this school have what it takes to get the children to learn” and “teachers here are well prepared to teach the subjects they are assigned to teach”. Likewise, teachers with strong collective efficacy are more likely to say they disagree with statements such as “students here aren’t motivated to learn” or “teachers in this school think there are some students that no one can reach” (Brinson & Steiner, 2007:2).

In addition to improved learner performance, teachers at schools with strong collective teacher efficacy appear to be more comfortable reaching out to parents (Brinson & Steiner, 2007:2). Ross and Gray (2006:192) suggesting that, because involving parents exposes teachers to the risk that parents will criticize the school or identify different goals or values than those identified by the school, therefore schools with low collective teacher efficacy are less likely to engage parents. A staff that is confident in their own abilities and their effectiveness, on the other hand, is more likely to welcome parental participation because they believe they will be able to withstand these challenges.

Teaching is typically performed in a group context, and many of the challenges that teachers face, require that they work together as a *collective* to change the lives of

their learners. Teachers' sense of efficacy is related to a number of school-level variables such as the behaviour of the principal, decision-making structures, sense of school community, and climate of the school. Furthermore, according to Motshekga (2011a:6), district support for schools that is often poor should be strengthened through, among other things, the development of job descriptions for circuit managers and subject advisors and the development of performance agreements with clear targets and deliverables.

In a study involving 1 981 K-8 teachers, Goddard and Skrla (2006:216-235) mention that contextual and demographic factors such as a school's socio-economic status, the experience level of the subject department, and learners' prior academic performance accounted for less than half (46 percent) of the differences in collective efficacy between schools. This suggests, according to Brinson and Steiner (2007:3), that there are several other factors at work in building collective efficacy that principals and district leaders can influence. The role of the principal is critical in sustaining teacher commitment by being attentive to personal and school context factors and critical in addressing the system contextual factors that diminish teacher commitment (Solomon, 2007:40).

The role of principals in the first decade of the new millennium has become more complicated than ever, with increased school and leadership accountability. The demands relating to the level of accountability, social issues, and standardized testing have created pressures that could not have been anticipated a decade ago (Solomon, 2007:21). The role

of principals in a study by Geist and Hoy (2004:7) found enabling bureaucracy to be strongly related to trust shown by staff members in the principal, describing the principal as the “embodiment of school structure,” and stated flatly that “the principal gets credit for good structures and the blame for the poor ones.” To meet the challenges of future schools, the new approach demands that “the principal, faculty, staff, parents, and the community work together sharing a vision of how to help all students achieve” (Lunenburg & Irby, 2006:5).

McGuigan (2005:74) states that the beliefs of staff members led to their responsibility for learning, which in turn led to both school policies and classroom practices that affected student learning. The policy practices of the school as a whole and the individual classroom practices of teachers each contribute to an environment that communicate to students the message that success was expected and is attainable. Hoy (2003:92) talks about the need for a school administration that is “flexible, sympathetic, supportive, and perhaps collegial,” and says that principals in an enabling school find ways to help teachers succeed rather than being obsessed with control and compliance. Principals as leaders of their schools are therefore supposed to transform their “old and redundant” leadership forms, discard them and adopt more collaborative forms of leadership (Grobler, Bisschoff & Beeka, 2012:40).

School practices that contribute to academic emphasis include policies relating to school function and structure, such as those designed to keep academic goals paramount, protect instructional time, promote an orderly school environment, and policies on

student progress such as homework policies, grading policies, and processes for monitoring student performance (McGuigan, 2005:74). Professional learning communities like universities and other institutions of higher learning should engage school staff members in processes that collectively seek new knowledge and processes. Schools that operate with professional learning communities go far beyond issues of schedules, discipline, fundraising etc., but also address the issues at the core of the mission – *effective teaching, learning- and assessment*. Hord (2004:9) states, “Such collaborative work is grounded in reflective dialogue or inquiry, where the staff members conduct conversations about students, teaching and learning, and identifying related issues and problems.”

1.5.2 Implementation of curriculum changes in mathematics

In spite of changes in the discourse of mathematics education, the relationship between the teacher and the learner remains unchallenged, because of the assertion of policy makers that the teacher is in a position of control and makes the difference in the learner’s achievement (Walls, 2004:1). A critique of teacher-directed pedagogies is found in Malloy (2002:18), who suggests that the idea of children having democratic access to powerful mathematics is a human right and “democratic education is collective in its goals and individual in its opportunities for student participation”. Skovsmose and Valero (2002:394) argue that “mathematics education becomes powerful in a cultural sense when it supports people’s empowerment in relation to their life conditions”.

Curriculum change after the political transition in the South Africa, according to Chisholm (2003:1) was undertaken in three main stages, namely: the *first* involved the ‘cleansing’ of the curriculum of its racist and sexist elements; the *second* involved the implementation of outcomes-based education through Curriculum 2005(C2005) and the *third* involved the review and revision of C2005 in the light of recommendations made by a Ministerial Committee. A postmodern ethical orientation to mathematics education however “is shifting the focus away from procedural compliance and onto the direct ethical relationship between teachers and students” (Neyland, 2004:69). A compelling vision of child-inclusive schools is provided by the UNICEF (2003:89) report on the state of the world’s children which mentions that one of the listed characteristics of a child-friendly school is “it involves children in active participatory learning”. UNICEF (2003:93) argues that a *human rights approach* is needed in efforts to improve conditions for children, in which “people are recognized as key factors in their own development, rather than passive recipients of commodities and services”, and where “participation is both a means and a goal.”

Teacher education, both pre-service and ongoing professional development, is increasingly in the spotlight, indexing recognition that the production of quality teaching is central to any education system (Adler, 2007:1). Presently in mathematics education there is a growing interest concerning the kinds of knowledge. The framework consists of four “distinct domains” namely *common content knowledge* – the mathematical knowledge of the school curriculum, *specialized content knowledge* – the mathematical knowledge that teachers use in teaching that goes beyond the mathematics of the

curriculum itself, *knowledge of students and content* – the intersection of knowledge about students and the knowledge about mathematics, and *knowledge of teaching and content* – intersection of knowledge about teaching and knowledge about mathematics (Ball, Bass, Sleep & Thames, 2005:4).

Classroom level practices that contribute to academic emphasis include an academically demanding classroom climate, an orderly classroom, practices to ensure learner academic successes, instructional practices that foster achievement, and opportunities for learner responsibility and leadership. These school and classroom factors affect students in three ways namely by establishing academic norms among students, by enhancing students' academic self-concept, and developing a sense of academic self-efficacy in students (McGuigan, 2005:74). Any intervention, according to Van der Walt and Maree (2007:238) to change classroom practice, should start with the teachers in their classrooms as a starting point for reflection on their experiences and to deliver critique on best practices.

1.6 METHODOLOGY

1.6.1 Research paradigms

Paradigms are one of the research decisions to consider when developing valid and coherent research designs, which act as perspectives to provide a rationale for the research and commit the researcher to particular methods of data collection, observation and interpretation (Terre Blanche & Durrheim, 2002:36).

The research into the effect of collective efficacy on the implementation of a new curriculum in mathematics in disadvantaged schools will mainly be conducted in the qualitative paradigm, although quantitative data are also used in the collection and analysis phases of the research. A combination of qualitative data (verbal) and quantitative data (numbers) will be used in the collection and the analysis of data, but the interpretation of the data is done qualitatively. Both qualitative and quantitative approaches are adopted, hence warranting a mixed method approach to this study.

Mixed methods is defined as the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study (Johnson & Onwuegbuzie, 2004:17). It is an expansive, inclusive, pluralistic and complementary form of research and suggests that researchers take an eclectic approach to method selection and the thinking and conduct of research in answering the research question. Mixed methods research is therefore both a methodology and a method, and it involves collecting, analyzing, and mixing qualitative and quantitative approaches in a single study or a series of studies (Creswell, Shope, Clark & Green, 2006:1).

1.6.2 Research approach

Both a qualitative and a quantitative research approach are adopted into this study which investigates the effect of collective efficacy on mathematics teachers implementing a new curriculum. The research topic is conducted mainly in the interpretive paradigm, as the study deals with perceptions and perspectives of mathematics teachers, but also uses a

quantitative approach in the positivist paradigm, with regard to data collection and analysis. The interpretation of the findings is done qualitatively, because the study deals with innate attributes of teachers, which can only be interpreted within the interpretive paradigm.

The mixed method approach of this study manifests itself in the research design, data collection, data analysis and the interpretation of the findings. The research design includes a qualitative ethnographic design, whereby interviews are used to collect data and the analysis is done through a summary of different themes. The quantitative research design includes a survey, which is non-experimental, to collect data and use statistical analysis to analyze the data. A mathematical test for the grade twelve learners, which is quantitative in nature, is used to consolidate the different efficacy relationships in the study. The summary of the findings which is done qualitatively either confirms or dispels findings of previous research on the topic.

1.6.3 Research design

A mixed method research design is adopted for this study which includes both a qualitative research design (ethnographic study) and a quantitative research design which is non-experimental (survey).

The relationship of the responses from mathematics teachers in terms of their own collective efficacy, how those responses influence mathematics learners about the new curriculum and how collective efficacy of both teachers and learners impacts upon the

academic achievement of mathematics learners, is investigated. A qualitative design is required to investigate perceptions and perspectives of mathematics teachers. The nature of the research question expresses a relationship between collective efficacy and curriculum implementation, hence requiring a quantitative research design or statistical approach Neuman (2006:161) in terms of data collection and data analysis. Both quantitative and qualitative methods, according to Babbie (2004:27) are useful and legitimate in social science, and both these approaches call for different skills and procedures.

- **Qualitative research design**

A qualitative research design for this study is adopted to provide answers to the primary and sub-ordinate research questions of this study. Qualitative research designs according to Neuman (2006:158) emphasize the social context for understanding the social world. When the researcher removes an event, social action, answer or conversation from the social context in which it appears, the social meaning and significance are distorted. Attention to context implies that the same events or behaviours can have different meanings in different cultures or historical eras (Neuman, 2006:158).

Johnson and Onwuegbuzie (2004:1) state that all research in the social sciences attempts to provide warranted assertions about human beings (or specific groups of human beings) and the environments in which they live and evolve. Qualitative research designs, as part of social science research, that have been developed include three types, namely: ethnographic studies, case studies and life histories. The research design for this study encompasses an *ethnographic study* of the impact of collective efficacy on

mathematics teachers implementing changes of a mathematics curriculum. Ethnographic studies are therefore studies aimed at describing and understanding different cultures and societies.

The investigation of the effect of collective efficacy on mathematics teachers includes different perceptions and perspectives of teachers which are subjective and unique within their respective surroundings. Babbie and Mouton (2010:xxx) describe ethnographic studies as qualitative research studies that are close to research subjects in their natural setting in order to describe and understand the world through their eyes. The aim of ethnographic qualitative studies is therefore to describe and understand different cultures and societies in their natural settings.

Social research, according to Babbie and Mouton (2010:79), serves three common and useful purposes which are exploration, description and explanation. The research design for this study is to *explore* the effect of collective efficacy on mathematics teachers in order to satisfy the researcher's curiosity and desire for a better understanding. The social context in which the research takes place, namely schools situated in previously disadvantaged communities, is an important consideration for a qualitative research design.

The limitations of generalization of results generated by this study are carefully considered, because of the ethnographic nature of the sample, in terms of its nature and its location. Against this background the research methodology implies that the findings

of the study lack the ability to generalize if the methodology is qualitative in nature (Mouton, 2004:151).

- **Quantitative research design**

The variable, according to Neuman (2006:160), is a concept that varies, and quantitative research designs therefore use a language of variables and relationships among variables. The quantitative research design for this study is a survey in the form of two questionnaires namely a collective efficacy questionnaire for all the teachers, a self-efficacy questionnaire for all the mathematics teachers at the sample schools and a mathematics test for grade twelve learners.

Survey research is perhaps the most frequently used research design in social sciences (Babbie & Mouton, 2010:230). One of the most important factors that contribute to the popularity of surveys relates to the advances in computer technology, which has made the analysis of large data sets possible (Babbie & Mouton, 2010:231). It is also suggested by Babbie and Mouton (2010:131) that social conditions that prevail in developed countries provides the context for the suggested applications of procedures such as surveys in these contexts.

Surveys are particularly well-suited to the study of public opinion (Babbie, 2004:110), as this study suggests how teachers, regarding their perceptions and perspectives of collective efficacy among themselves in a school, can influence not only learner outcomes, but also learner attainment in mathematics.

The limitations of a quantitative research design is that the findings of such a study are sometimes very sample and context-specific if the methodology is quantitative in nature (Mouton, 2004:153).

1.6.4 Population

A researcher draws a sample from a larger pool of cases. The large pool is the *population*, which is defined in the context of the unit being sampled, the geographical location and the temporal boundaries of populations (Neuman, 2006:224).

The population for a study, according to Babbie (2004:10), is that group (usually *people* in social science research) about whom we want to draw conclusions. The population for this study includes mathematics teachers and learners, who are subjected to a new mathematics curriculum being implemented by the National Department of Education, and find themselves in secondary schools which are situated in previously disadvantaged communities in the Eastern Cape.

1.6.5 Sample

Sampling, according to Neuman (2006:219), are precise procedures used to obtain statistically acceptable and analyzable data, and samples are therefore used to obtain true values or parameters of statistics in a population with a calculable probability of error. A sample in a research study is therefore a group from which information is obtained (Fraenkel & Wallen, 2006:92).

The type of sampling for this study is purposive sampling, because the researcher is selecting the sample on the basis of knowledge of the population, its elements and the purpose of the study (Babbie, 2004:183). The site selection for this study includes three secondary schools, situated in previously disadvantaged communities, namely Indian, Coloured and Black residential areas in East London. The selection of these schools is based on social, political and economical disparities. These schools are situated in communities which are faced with challenges of illiteracy, unemployment, poverty and are in cases also marginalized in terms of services such as clean water, electricity and proper sanitation.

The research participants include all teachers from the sample schools for a baseline assessment questionnaire (refer to Appendix A) which evaluates the collective efficacy of all the teachers ($n = 100$) of the sample schools. The sample further includes all the mathematics teachers ($n = 16$) in the sample schools, who responded to questions surrounding their perceptions and perspectives about their own efficacy regarding the implementation of the new curriculum (refer to Appendix B). The mathematics teachers teaching grade eleven ($n = 6$) in the sample schools, also gave insight through interviews (refer to Appendix C) into curriculum implementation issues of the respective schools. A mathematics test (refer to Appendix D) also probed grade twelve mathematics learners ($n = 100$) in the sample schools in terms of their conceptual understanding, to assess their responses in terms of new curriculum content which they learnt in grade eleven.

1.6.6 Data gathering instruments

The questionnaire for this study addresses school conditions for effective teaching and learning, whereby the first questionnaire (Appendix A) is completed by the whole staff ($n = 100$) regarding managerial, financial, leadership, curricular and a range of other institutional issues. This questionnaire attempts to probe responses from all the teachers regarding their perceptions and perspectives of their schools. The second questionnaire (Appendix B) was administered to the mathematics teachers ($n = 16$) of the sample schools, in which the responses regarding the effectiveness of mathematics teachers in the implementation of curriculum content in the respective classrooms of these teachers are gathered.

Semi-structured interviews (Appendix C) were held with the mathematics teachers ($n = 6$) teaching grade eleven learners in the sample schools to consolidate responses collected from the questionnaires regarding the different efficacy relations pertaining to this study. These semi-structured interviews were held to consolidate the responses of the questionnaires which the mathematics teachers had completed.

A mathematics test (Appendix D) was administered to grade twelve learners ($n = 100$) of all three sample schools as a measure to consolidate the different relationships for the proposed study. This test included the core disciplines in the National Curriculum Statement (NCS) mathematics curriculum for grade eleven, with a multiple-choice option of four possible answers. These tests were also administered and supervised under conditions as prescribed by test and examination regulations of the sample schools.

1.6.7 Data Analysis

All fieldwork culminates in the analysis and interpretation of some set of data (Mouton, 2004:108), be it qualitative transcripts and recordings or quantitative survey data in the form of questionnaires and a mathematics test, as it applies to this study.

For qualitative content analysis, *interpretation* means firstly relating one's results and findings to existing paradigms and models, and showing whether these are supported or falsified by new interpretation. Interpretation also means taking into account rival explanations or interpretations of one's data and showing what levels of support the data provide for the preferred interpretation (Mouton, 2004:109).

For quantitative content analysis, the researcher has to understand the various constitutive elements of one's data through an inspection of the relationships between concepts, constructs, or variables. Secondly, it is also important for the researcher to see whether there are any patterns or trends that can be identified or isolated, or to establish themes in the data (Mouton, 2004:108).

1.7 ETHICAL CONSIDERATIONS

Ethical issues arise from our interaction with other people, other beings (such as animals) and the environment, especially at the point where there is potential or actual conflict of interests. The scientist, according to Mouton (2004: 239) has the right to search for truth, but not at the expense of the rights of other individuals in society.

The ethics guidelines for this study include two aspects, namely: *the relationship to practice of science (professional ethics)* and *the relationship to the subjects (research participants) of science*.

1.7.1 Relationship to the practice of science (professional ethics)

The ethic guidelines for professional ethics are outlined in accordance to Mouton (2004:239-241). The ultimate goal of all science is to search for the truth (Mouton, 2004:239). The search for the truth should translate itself into maintaining objectivity and integrity in the conduct of scientific research (Mouton, 2004:240).

At no point or under no circumstances will the observations or data be changed or fabricated, as this would amount to one of the most serious transgressions in scientific research (Mouton, 2004:240).

The findings of scientific research should be disclosed to the greater scientific community in terms of methodology and techniques of data analysis. This disclosure of information however, should not happen when the participant's right to proprietary information and privacy is compromised (Mouton, 2004:240).

This study contains appropriate reference to the contributions made by all participants in the research, in accordance with the ethics of publishing (Mouton, 2004:241).

One ethical principle of scientific publication is the rejection of plagiarism, hence implying that every source that has been consulted, either directly or indirectly is acknowledged (Mouton, 2004:241).

1.7.2 Relationship to the subjects (research participants) of science

The ethics guidelines for research include three principles, namely *consent, confidentiality and competence* (Terre Blanche & Durrheim, 2002:66-69).

Participation in this research is voluntary. All the research participants received a clear explanation of the tasks required from them so they can make informed decisions to participate (Terre Blanche & Durrheim, 2002:66).

The participants were assured about the parameters of confidentiality and anonymity of the information supplied by them in terms of the format of the publication of their research results (Terre Blanche & Durrheim, 2002:68).

The participants were also informed that the research is conducted within the boundaries of an educational field by an education scholar, and no interference into any other professional field is assured (Terre Blanche & Durrheim, 2002:69).

1.8 DIVISION OF CHAPTERS

This thesis consists of six chapters as follows:

1.8.1 Chapter One: Introduction

Chapter one gives a general introduction and overview to the study in terms of the effect of collective efficacy on curriculum implementation, states the research problem and questions, introduces the methodology and provides a broad outline of the chapters for this thesis.

1.8.2 Chapter Two: Literature review on collective efficacy and the changes in the mathematics curriculum

In chapter two a detailed literature review of two main themes is outlined namely collective efficacy and the implementation of a new curriculum in mathematics. It is within the context of existing paradigms and philosophical underpinnings that a historical account of the research on collective efficacy and the mathematics curriculum is given. The paradigm is guided, not only by conceptual issues on collective efficacy and curriculum implementation, but also by issues of best practices of a learner-centred approach of mathematics education in South African classrooms.

1.8.3 Chapter Three: Research methodology

Chapter three provides a detailed outline to gather information. Information gathering and analysis form the basis on which the theoretical framework for the

proposed study will be researched. The methodology section provides detailed explanations about theoretical and practical issues surrounding data collection techniques. The manner in which data is collected, as part of a particular research method of data collection (questionnaires, interviews for teachers and a mathematics test for learners), is justified in terms of the context and the type of the data.

1.8.4 Chapter Four: Data presentation, discussion and analysis

Chapter four includes the data generated by using methods described in chapter three. The presentation of these results is described within the framework as set out by the study's primary and sub-ordinate questions. These discussions and analysis are presented as text, tables and graphs.

1.8.5 Chapter Five: Research findings

Discussion of the results in chapter four is done in chapter five, within the theoretical framework in chapter two i.e., by reflecting on results and findings within existing theoretical frameworks or models, and by interpreting the data in terms of whether they support or falsify existing frameworks or models (Mouton, 2004:124).

1.8.6 Chapter Six: Summary, recommendations and conclusion

Firstly, the summary of the results and research findings are discussed and general conclusions are drawn, within the limitation of the research question. Secondly,

recommendations are made based on the research findings to improve better attainment levels in mathematics as well as recommendations for further research. Finally, conclusions are drawn from the entire research findings, which give answers to the primary research question of this study.

CHAPTER TWO

LITERATURE REVIEW ON COLLECTIVE EFFICACY AND THE CHANGES IN THE MATHEMATICS CURRICULUM

2.1 INTRODUCTION

The literature review represents the theoretical core of an article (Kotze, 2007:19), and the purpose of a literature review is to review previous research on the topic (Leedy & Ormrod, 2005:70). Rubin and Babbie (2001: 51) define a theory as follows: “[a] theory is a systematic set of interrelated statements intended to explain some aspect of social life or enrich our sense of how people conduct and find meaning in their daily lives.” Literature reviews provide background to and serve as motivation for the objectives and hypotheses that guide one’s own research (Perry, Carson & Gilmore, 2003:660). The literature review does not merely summarize relevant previous research, but critically evaluates, re-organizes and synthesizes the work of others (Leedy & Ormrod, 2005:84).

A detailed review of the literature on collective efficacy and the changes in the curriculum are outlined, within the context of previous research on collective efficacy and the possible effect it could have in implementing a new curriculum. The review of literature for this study, with reference to previous research focuses on two main themes namely on literature of previous research being done on *collective efficacy* and *the implementation of curriculum changes* in South African schools.

This chapter reviews previous research on collective efficacy within the context of a historical perspective of various definitions, existing paradigms and philosophical underpinnings. The effect of collective efficacy, within the context of implementing curriculum changes in mathematics in secondary schools, which is situated in previously disadvantaged communities, is investigated. The literature review also deals with the implementation of the National Curriculum Statement (NCS) for mathematics in the above-mentioned secondary schools, providing insight into perceptions and perspectives of teachers and the conceptual understanding of mathematics by learners.

2.2 COLLECTIVE EFFICACY INITIATIVES AND LEARNER PERFORMANCE

It is well documented and publicized that the numeracy and literacy performance of South African learners in cross-country comparative studies (TIMSS, 2003) remains poor compared to several of the less resourced neighbouring states. The Trends in International Mathematics and Science Study (TIMSS) and Progress in the International Reading and Literacy Study (PIRLS) international assessments over the past decade have, according to Motshekga (2011b:1), pointed to difficulties with the quality of literacy and numeracy in South African schools.

The third round of data production in TIMSS undertaken in Grades 8 & 9 in 2002 in South Africa by the Human Science Research Council (HSRC) (Reddy 2004), well after the introduction of OBE and C2005, clearly shows as a benchmarking instrument that South African mathematics learners underperform, when compared to learner

achievement of mathematics in other international countries. The data in the TIMSS study (HSRC) (Reddy 2004) are analyzed without considering the context of introducing a new curriculum for mathematics, hence ignoring the implications of the changes introduced through new curriculum reforms.

It is against this background that the National Department of Education (DOE) in October 2008 embarked on a collective efficacy initiative. This initiative by the Education Department was viewed as an intervention programme, where teacher unions, parents and other stakeholders launched the *Quality Learning and Teaching Campaign*, which has called on all individuals, organizations and communities to assume responsibility for improving the quality of education, and even committing teachers, school governing bodies, learners and the national and provincial departments to a *Code for Quality Education* which sets out the responsibilities and discipline requirements of all the stakeholders (Motshekga, 2009:2).

2.3 COLLECTIVE EFFICACY

The concept of collective efficacy is not an isolated concept, and needs to be put into context within a broader theoretical framework of *social cognitive theory* which includes both the concepts of self-efficacy and collective efficacy.

2.3.1 Theoretical framework of social cognitive theory

Social cognitive theory, according to research by Pajares (2002) is based on the assumption that human choices are based on a combination of personal factors (cognitive, emotional or biological state), behavioural factors (one's actions and reactions toward stimuli) and environmental factors (social, cultural, religious and economic conditions). Self-efficacy is a major determinant of the choices that individuals make, the effort they expend, the perseverance they exert in the face of difficulties, and the thought patterns and emotional reactions they experience (Nicolaidou & Philippou, 2003:3). The study of collective efficacy of individuals within a specific context is relevant to this study, which takes into consideration all the factors that influence the beliefs of those individuals.

2.3.2 Teacher self-efficacy

Teacher efficacy was derived from Bandura's (1977) conceptualization of self-efficacy, which is defined as individuals' judgments of their capabilities to accomplish certain levels of performance, and the assertion that self-efficacy beliefs govern most of human functioning and mediates on how individuals think, feel, motivate themselves and behave (Swars, 2005:139).

Developing from social cognitive theory (Bandura, 1986, 1993 & 1997), Henson (2001:4) defines teacher self-efficacy as a teacher's judgment of his/her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated (refer to Appendix B).

For the purposes of this study it is important that the concept of teacher self-efficacy is put into perspective. The influence of self-efficacy beliefs for both teachers and learners has profound consequences on the manner in which effective teaching and learning take place, especially when the educational setting is surrounded by adverse socio-economic conditions.

2.3.3 Collective efficacy

Perceived collective efficacy is a construct derived from social cognitive theory that is based on the assumption that the choices that individuals and organizations (through the actions of individuals) make are influenced by the strength of their efficacy beliefs (Goddard, Hoy, & Woolfolk Hoy, 2004:4). Bandura (1977:478) argues that although personal efficacy (individual) and perceived collective efficacy (group) differ in their units of agency, both forms of efficacy beliefs have similar sources, serve similar functions, and operate through similar processes.

Studies by Bandura (1986,1997) identify four sources of efficacy information namely: *mastery experience* (a perception that a performance has been successful contributes to the assessment that similar proficiency can be expected in the future), *vicarious experience* (beliefs that are shaped when observers identify themselves with those whose performances are successful), *social persuasion* (encouragement or feedback concerning particular performances which depend on the credibility, trustworthiness and expertise of the persuader) and *affective state* (the manner in which groups or organizations interpret and react to changes that they face).

Goddard, Hoy, and Woolfolk Hoy (2000:9) point out that two other major influences of collective efficacy in schools include the *teaching task* and *teaching competence*. Goddard *et al.* (2000:9) state that the perceptions of a group's capability to successfully educate learners occur when teachers consider the level of difficulty of the teaching task in relation to their perceptions of group competence. They further suggest that this process occurs at both individual and school levels as "teachers analyze what constitutes successful teaching in their school, what barriers or limitations must be overcome and what resources are available to achieve success"(Goddard *et al.*,2000:9).

Collective efficacy (refer to Appendix B) is a group manifestation of the concept of teacher self-efficacy (McGuigan, 2005:38). A theoretical foundation of self-efficacy is found in social cognitive theory, developed by Bandura (1986, 1993 & 1997), which contributed to the development of teacher-self efficacy. Nicolaidou and Philippou (2003:1) note that a person's behaviour and choices, when confronted by a task, are determined more by his/her beliefs and personal theories rather by his/her knowledge of the specifics of the task.

In the study of teacher collective efficacy, the unit of analysis shifts from the individual to the group. Collective efficacy is an important school property, hence becoming an emergent group-level attribute, the product of interactive dynamics of the group members (Solomon: 2007:51).

Collective efficacy (refer to Appendix A) is therefore also the perception of teachers in a school that the efforts of the institution as a whole will have a positive impact on student learning (Brinson & Steiner, 2007:1). In research performed on the wellbeing of South African educators, it was found that educators did not experience their work places as positive, and therefore experienced a negative organizational climate (Jackson & Rothmann, 2006, 75-95). All the stakeholders in a school must therefore jointly work and grow together to achieve defined goals for teachers and learners. Hord (2004:8) mentions that “administrators, along with teachers, must be learners - questioning, investigating and seeking solutions for school improvement and increased student motivation”.

2.3.4 Teaching and learning cultures in schools

Teachers, curriculum developers and even policy makers are continuously searching for factors within the control of schools that can increase the academic achievement of learners. This search is driven by legal mandates in terms of the role and responsibility of teachers, by an increased emphasis on the academic achievement of learners at every achievement level, and an increasing belief that schools can and do make a difference in learning outcomes of under-achieving learners. Taken as a collective, research on school effectiveness and school improvement presents a few surprisingly clear and consistent conclusions. The research by McGuigan (2005) shows that effective schools have strong leaders, who put in place structures and processes that facilitate teacher co-operation in developing effective instructional techniques, who foster

teacher capabilities and confidence and who clarify the goals and academic mission of the school,(refer to Appendix A, Category 1).

Goddard (2002:18) indicates that the more teachers are given the power to influence school decisions concerning the instructional programme, the greater their levels of perceived collective efficacy. McGuigan (2005:55) found that one dimension of teacher empowerment was “impact”, defined as “the degree to which one’s behaviour is perceived as producing intended effects on one’s task environment”. Research by Vos, Van der Westhuizen, Mentz and Ellis (2012:55-68) also found that the manner in which principals handle the management tasks or functions of schools influence how personnel experience the activities in the school and can therefore influence the work atmosphere in the school. Hoy (2003:92) mentions the need for a school administration to be flexible, sympathetic, supportive and perhaps collegial,” and says that principals in enabling schools find ways to help teachers succeed rather than being obsessed with control and compliance. In a study by Roberts and Roach (2006) it was found that where the true distribution of leadership, systems and procedures are entrenched and leadership functions have been shared, such schools function well, even in the absence of the principal. Effective school management and leadership are key factors in ensuring effective schooling (refer to Appendix A, Category 6), and it is for this reason that all principals and deputy principals in South African schools will enter into performance contracts with clear performance targets (Motshekga, 2011b:6).

The principal as the instructional leader is expected to help the school community to develop a shared vision for the school. *Vision* is by its nature future directed and therefore projects a desire future state for the school and this implies that the school is striving to attain something different from its current state. Curriculum planning, which is guided by an outcomes based approach to teaching, learning and assessment strategies, available resources to execute such plans (refer to Appendix A, Category 4) and curriculum delivery which include effective teaching, learning and assessment activities in the classroom, should be informed by the shared vision of the school. If curriculum delivery is the most important function of the school, then instructional leadership, which is the principal's connection to the classroom, is one of the main aspects of the management of schools. Research by Roberts and Roach (2006) indicate that shared vision and staff co-operation feature high amongst key factors that have been associated with effective schools. Hord (2004:9) defines a shared vision as a strong mental image of what is important to the individuals and the organization, and states that an organization that functions for the common good is "on par with personal ambition". Teachers are therefore encouraged to get involved in defining and sustaining the vision of schools, and accept accountability for decisions they make on the basis of those visions and values (Mawhinney, Haas & Wood, 2005:11). An understanding of teachers' commitment in accomplishing the goals of the school is important, because it reflects their personal interpretation of how absorbing and meaningful their work experiences are (Solomon: 2007:31).

A school culture in which teachers collaborate around teaching and learning is beneficial for both teachers and learners (Puchner & Taylor, 2006:922). Previous research (Huffmam & Kalnin, 2003) has noted that collaboration among teachers has been identified as one of the most important features of a school culture that fosters professional development, teacher satisfaction, teacher effectiveness, and learner achievement within a school. Hoy and Miskel (2005:179) also point out that research shows that “a strong culture of efficacy seems to promote high learner achievement, in part, because it leads to the acceptance of challenging goals, strong organizational effort, and a persistence that leads to better performance” (refer to Appendix A, Category 2). Puchner and Taylor (2006:931) claim that the link between collaborative work, collegiality, and positive outcomes in schools is well established.

Classroom practices (refer to Appendix A, Category 3) that include effective teaching, effective learning and effective assessment activities contribute to an academically demanding classroom climate, an orderly classroom atmosphere and practices that ensure academic success of learners (McGuigan, 2005:74). *Classroom climate* describes more specifically the atmosphere wherein interaction between learners and the teacher takes place, and differs from classroom to classroom (Van der Westhuizen, Mosoge, Swanepoel & Coetzee, 2005, 89-105)

The challenge for this study is whether positive outcomes will materialize when curriculum changes are introduced, taught and assessed, within a context of adverse socio-economic hindrances these teachers and learners are faced with.

2.3.5 Teacher efficacy on mathematics teaching

Teacher efficacy is a significant predictor of mathematics instructional strategies, and highly efficacious teachers are more effective mathematics teachers than teachers with a lower sense of efficacy (Swars, 2005:139).

Although there are many studies concerning teacher efficacy, there is limited research on mathematics teacher efficacy (Swars, 2005:140). In the few studies on mathematics teacher efficacy (Cakiroglu, 2000; Wenta, 2000), according to Swars (2005:140) it was found that pre-service teachers' participation in a mathematics method course correspond to significant increases in mathematics teacher efficacy. Pre-service teachers also reported (Cakiroglu, 2000) that having exposure to reform approaches in a mathematics course, influenced their levels of mathematics teacher efficacy positively (Swars, 2005:140).

It is within the context of limited research in the area of mathematics teacher efficacy, together with teacher self-efficacy regarding instructional practices and a willingness to embrace reform within a changing curriculum (refer to Appendix A, Category 5), that this study was undertaken. In order to facilitate the development of highly efficacious mathematics teachers, the perceptions regarding mathematics teacher efficacy, within the context of a changing curriculum in mathematics are investigated.

The manner in which the education process of learners is influenced by self-efficacy levels of teachers and learners, together with the level of collective efficacy

beliefs of the learning institution as a whole, form the foundation for equipping learners with the required knowledge, skills, attitudes and values, in order to ensure the successful implementation of the changes in the mathematics curriculum.

2.3.6 Collective efficacy on learner achievement

Bandura (1993) was the first person to explore the link between collective efficacy and academic achievement, concluding those teachers' beliefs in collective ability to teach learners in a school were associated with the school's aggregate academic performance, and that these effects were stronger than the effects of socio-economic status or prior academic achievement.

In the research by Mawhinney, Haas and Wood (2005:22) it is stated that, based on the relationship between collective efficacy beliefs and learner achievement in reading, the perceptions of professional learning communities and learner achievement are not easy to disentangle from the context of schools, where differences in socio-economic and minority status of learners are strongly related to learner achievement.

Previous research by Goddard, Hoy and Woolfolk Hoy (2000) also demonstrates that collective teacher efficacy has a strong measurable effect on the academic performance of learners (refer to Appendix C, Theme 3). Goddard *et al.* (2000) found that even taking into consideration the effect of the learners' demographics such as race, socio-economic status and gender (factors beyond the control of the school), perceptions

of collective efficacy were stronger predictors of academic achievement (Brinson & Steiner, 2007:2).

The academic goals achieved by mathematics learners (refer to Appendix D4), within the context of different collective efficacy relations, are therefore an important indicator as to whether teachers and learners have adapted appropriately to curriculum reforms, and could also assess whether the strategies to deal with the challenges imposed by the implementation of these curriculum changes, are successful.

2.3.7 Parent and teacher support for children (learners)

Gill, Ashton and Algina (2004) tested a model of effective schools based on research of effective parenting. The effective parenting model used a two dimensional theoretical structure across the dimensions of *demanding* and *responsive*. It was found by these researchers (Gill *et al.*, 2004) that effective parents are high in both dimensions, insistent on high standards for behaviour but also warm, affectionate, and responsive to the needs of their children.

Research by Friedel, Cortina, Turner and Midgley (2007:434) examines children's perceptions of the achievement goals parents and teachers emphasize for them in mathematics, and the relation of these goals to children's personal achievement goals, self-efficacy beliefs, and coping strategies. It was found by the research of Friedal *et al.* (2007) that these goals are achieved in a particular educational setting surrounded by

specific socio-economic and other factors that impact on teaching and learning, including the self-efficacy beliefs of parents, teachers and children (learners).

Research regarding children's achievement goals has consistently demonstrated that the achievement goals children adopt are related to a variety of children's academic out-comes, including children's beliefs about their ability to achieve (Middleton, Kaplan, & Midgley, 2004). Further, this research (Middleton *et al.*, 2004) has yielded evidence that the achievement beliefs and behaviours they adopt, reflect to some extent the "goal structure of the classroom practices". In a similar vein, researchers (Friedel *et al.*, 2007) have examined parents' beliefs and practices as they relate to children's academic outcomes, including parents' expectations and attributions for children's academic outcomes.

The goals teachers emphasize for children have important consequences for children's motivation and achievement. Several lines of research have examined the relation between the goal structure of the classroom context and children's personal goal orientations, ability, beliefs, and learning behaviours from an ecological point of view (Middleton *et al.*, 2004). This research, as mentioned by Middleton *et al.* (2004), regards the school context as only one of the environments in which children's interactions with others might influence their achievement goals, beliefs and behaviours. Contextual cues and interactions with others are therefore interpreted and acted upon differently within the school context, depending on a variety of situations and contexts. Parents in particular are an important source of academic advice, encouragement, and assistance for many

children and educational research in general has led to the conclusion that parent involvement in its many and varied forms is an important factor in promoting learner achievement.

Research by Friedel *et al.* (2007) highlights the contextual nature of children's achievement goals, efficacy beliefs and coping strategies. Most importantly, the study demonstrated that the goals children perceive parents to emphasize, in addition to those they perceive teachers to emphasize in classrooms, are related to the goals children adopt, and indirectly to children's beliefs regarding the possibility of success in mathematics as well as the strategies they use to cope with academic difficulty.

Educational research (Pintrich & Schunk, 2002; Stipek, 2002) has shown that changing motivational and attitudinal variables can affect academic performance. This research found that changing less optimal causal attributes into more optimal attributes will enhance learner motivation and achievement (Moodaley, Grobler & Lens, 2006:635).

It is within the context of low attainment levels of mathematics by South African learners, that collective efficacy beliefs of all the teachers in schools are such critical factors in creating conducive conditions for effective teaching, learning and assessment. Collective efficacy is prerequisite for effective curriculum practices of all teachers, hence creating positive teaching and learning cultures in the mathematics classrooms of especially disadvantaged schools, which lead to better attainment levels in mathematics.

2.4 THE IMPLEMENTATION OF CURRICULUM CHANGES

2.4.1 A historical perspective

It is well documented that in 1948 the South African government introduced the system of apartheid, where institutions were established along racial lines and where a doctrine of inequality was enforced. These doctrines were enforced in the education system firstly through legislation (The Bantu Education Act, 1953), which introduced inferior education, unequal distribution of resources, poor teacher training, and unacceptable teacher:learner ratios, and then through regulations, namely: the Corresponding Colleges Act (1965) and the Technical Colleges Act (1981, and amended in 1989) which regulated certain institutions of higher learning (DOE, 2003a:1).

South Africa's democratic government inherited a divided and unequal system of education in 1994. South Africa had nineteen different educational departments prior to 1994 and was separated by race, geography and ideology. This apartheid education system prepared children in different ways for the positions they were expected to occupy in social, economic and political life under apartheid. In each education department, the curriculum played an important role to reinforce inequality, and the manner in which children were taught in these departments differed according to the roles they were expected to play in wider society (Education Labour Relations Council, ELRC, 2003:H44).

In 1994 the political landscape of South Africa was changed when political power was peacefully passed from a white minority government to a democratically elected government. These political changes, spearheaded by an ANC-led government, consequently not only addressed the inequalities of the education system, but also brought about reforms of the national curriculum which underpinned the ideologies and philosophies which are guided by a constitutional democracy. A consequence of that change was a White Paper, published by the National Department of Education (1997), which was designed to guide education policy for the coming years. Curriculum 2005 (C2005) was the result of this government-driven change (Aldous, 2004:65).

In 1998 the new ANC-led government, with the then Professor Sibusiso Bengu as education minister, decided to phase out the old curriculum, under which different racial groups studied different curricula, and gradually replace it with a new curriculum (C2005). These curriculum reforms were not only taken as an academically sound decision, because of its views on lifelong learning, but it was also politically contextualized in that it provided lifelong learning opportunities for all South Africans, regardless of colour, race or gender.

South Africa has for the last twelve years been characterized by major transformation at all levels in the education system, in particular, radical school curriculum changes implemented since 1997 as “unprecedented in the history of curriculum reform” (Harley & Wedekind, 2004:195). Thus the key principle of the new curriculum is social transformation aimed at ensuring that the educational imbalances of

the past are addressed, and that equal educational opportunities are provided for all sections of our population (DOE, 2003b:2).

The Constitution of the Republic of South Africa (Act 108 of 1996) provides the basis for curriculum transformation and development in South Africa (DOE, 2002:1). The new curriculum aims to develop the full potential of each learner as a citizen of a democratic South Africa by healing the divisions of the past, improving the quality of life of all citizens, laying the foundations for a democratic and open society and building a united and democratic South Africa (DOE, 2002:1).

Curriculum change in post-apartheid South Africa started immediately after the election in 1994 when the National Education and Training Forum began a process of syllabus revision and subject rationalization, in order to lay the foundations for a single national core syllabus. The National Education and Training curriculum developers also removed overtly racist and other insensitive language from existing syllabi in order to heal the divisions of the past (ELRC, 2003:H44). The curriculum changes over time include the old *Nated 550 Curriculum* which was replaced with an *Outcomes-based Education* (OBE) approach in new curriculums, namely: *Curriculum 2005 (C2005)*, *Revised National Curriculum Statement (RNCS)* and then *National Curriculum Statement (NCS)*. The NCS was later adapted and reformed, because of implementation and administrative difficulties into another revised curriculum, namely the *Curriculum and Policy Statement (CAPS)*.

2.4.2 Outcomes-based education

American educationist Bill Spady became highly influential in curriculum planning and development in South Africa after 1994. In a report by the Review Committee on Curriculum 2005 (DOE, 2000:15) presented to the then Minister of Education, Professor Kader Asmal, it is mentioned that the Bill Spady's appeal to Curriculum 2005 lay in schemata he produced to distinguish between, amongst other things, 'traditional OBE' which is characterized by rote learning, subject divisions, content-based knowledge and summative assessment, and 'transformational OBE' which emphasized the opposite in that learning is shaped by outcomes, integrated knowledge and formative assessment. In outcomes-based education, according to Killen (2000:vii), all decisions about planning, teaching and evaluation are guided by four simple questions namely: What do we want learners to *learn*? Why do we want learners to *learn* these things? How can we best help learners to *learn* these things? How will we know whether learners have *learned*? It is clear that OBE is not an event, but a total approach to education that influences the whole school curriculum (Killen, 2000:x), since the core mission of any school is *learner attainment*.

The *Lifelong Learning through a National Curriculum Framework* (1966) was the first major curriculum statement of a democratic South Africa (Education Labour Relations Council, ELRC, 2003:H44). The first curriculum statement was informed from the White Paper on Education and Training (1995), the South African Qualification Act (No 58 of 1995) and the National Education Policy Act (No 27 of 1996), which emphasized the need for major changes in education and training in South Africa in order

to normalize and transform teaching in South Africa (ELRC, 2003:H44). This curriculum statement also stressed the need for a shift from the traditional *aims-objective approach* to *outcomes-based education*.

Outcomes-based education (refer to Appendix C, Theme 1) forms the foundation of the curriculum in South Africa (DOE, 2002:1). The curriculum aims to develop the full potential of each learner as a citizen of a democratic South Africa by encouraging learners to achieve to their maximum ability, by setting outcomes that are learner-centred and have an activity-based approach to education (DOE, 2002:1).

Outcomes-based education considers the process of learning as important as the content. Both the processes and the content of education are emphasized by spelling out the outcomes to be achieved at the end of the process. According to the Revised Curriculum Statement (RNCS) Grades R-9 (DOE, 2002:1) learning outcomes and assessment standards were designed *downwards* from the critical and developmental outcomes.

According to The Policy Handbook for Educators (ELRC, 2003:H46), the critical and developmental outcomes are a list of outcomes that are derived from the Constitution of South Africa and are contained in the South African Qualification Act (1995). The critical and developmental outcomes describe the kind of citizen the education and training system should aim to create (ELRC, 2003:H46). The kind of teacher that is envisaged includes being mediators of learning, interpreters and designers of Learning

Programmes and materials, leaders, administrators and managers, scholars, researchers and life-long learners, community members, citizens and pastors, assessors and Learning Area or Phase specialists. The kind of learner that is envisaged is a citizen who will act in the interest of a society based on respect for democracy, equality, human dignity, life and social justice (DOE, 2002:3).

By means of Learning Area Statements, the Revised National Curriculum Statement (DOE, 2002), identifies the goals, expectations and outcomes to be achieved through related learning outcomes and assessment standards. The learning outcomes for each learning area indicate the broad framework that a learner should achieve at the end of a learning process, whereby the assessment standards provide detailed skills, knowledge and attitudes requirements to be achieved in terms of the broader learning outcome. The learning outcomes and the assessment standards are cognitive and supportive of each other (DOE, 2002:6).

2.4.3 New teaching practices for curriculum change

A worldwide paradigm shift is taking place by which educational institutions are gradually changing from places where teaching is provided to places where learning is facilitated (Van der Walt, Maree & Ellis, 2008:206).

Curriculum 2005 (C2005) advocates a constructivist theory of learning which acknowledges that the teacher is not a transmitter of knowledge, but rather a facilitator and provider of experiences from which learners will learn. The constructivist theory

claims that knowledge is a social construct that is gained through inter-action with other people, hence advocates the use of teaching methods that ensure a more learner-centred approach in social constructivist classrooms in South Africa (Sebela, 2009:2).

The notion of constructivism is one of main pillars of Curriculum 2005, which is used as a reference to provide information around teaching practice regarding teaching styles and efforts to transform the classroom. The new curriculum (C2005) has an outcomes-based approach to education, which requires teaching methods that are learner-centred, an approach that requires learners to participate in classroom activities, become more involved in the learning process and take responsibility for their own learning (Sebela, 2009:2).

The view of learner-centredness is a transformational, research-validated perspective needed in building professional learning communities and improving schools (Crick, McCombs, Haddon, Broadfoot & Tew, 2007:272). A learner-centred approach to educational reform implies, according to Crick *et al.* (2007:267) that the focus is on the psychological, emotional and social needs of the learners, and could promote motivation, learning and achievement for all learners. Crick *et al.* (2007:268) states that the creation of learner-centred classrooms may be supported by the development of learners' ownership of their own learning power, hence making teacher learner-centred practices respectable in that they create a voice for learners through an emotionally literate school climate.

Other teaching practices, in terms of learner-centredness, require from teachers to give learners the opportunity to work at their own pace according to individual abilities and levels of cognitive development. The C2005 curriculum also advocates teaching practices that are of a *reflective nature*, by letting both teachers and learners reflect on predetermined outcomes that should be achieved during or at the end of each learning process.

2.4.4 The statement of the new curriculum

Rogan (2004:165) mentioned that the implementation of a new curriculum in South Africa, Curriculum 2005 (C2005), will pose enormous challenges in terms of its implementation and intrinsic values. Curriculum reform in the post-apartheid South Africa, as elsewhere, is concerned with changing the “bias and focus of official knowledge” in order to construct new pedagogic identities in teachers and learners (Bernstein, 2000:65).

The C2005 curriculum, according to Sebela (2009:2), also focuses on fostering learning that encompasses a culture of human rights, multi-lingualism, multi-culturalism and a sensitivity to the values of reconciliation and nation-building.

The foundation of C2005 is explicitly identified as *outcomes-based education* (OBE), which promotes a learner-centred and activity-based approach to education (DOE, 2003b:1). Outcomes-based education is a key aspect of Curriculum 2005, which is aimed at the activation of learners’ intellect to enable them to perform optimally and to equip them for lifelong learning (Van der Walt, Maree & Ellis, 2008:207).

The national curriculum policy reviews such as those interrogating the effectiveness of the introduction of first major post-Apartheid curriculum reforms of Outcomes-based Education and Curriculum 2005, and also in mathematics education (Vithal, Adler & Keitel, 2005; Adler & Reed, 2003) do not in the main refer to what learners say, experience and learn within the OBE system. Parker (2006:62) notes with concern that the terms *learner-centred* and *activity-based* are not clearly defined, and in the documents (DOE, 2003a & 2003b) it is assumed that these categories are well understood by teachers – which was clearly not the case. Yet, if education is, in the final analysis, about learners and what learners gain and take away from the curriculum, then one would assume that research and evaluation of outcomes-based education and C2005 would focus, as priority, on all aspects of outcomes themselves for learners. This is surprisingly not the case, as Harley and Wedekind (2003:3-4) state with respect to one key design feature of the new South African curriculum in which ironically learner-centeredness is given considerable priority., “The learners’ experience of classroom practice is the dimension of C2005 most poorly served by research”, and identify as a gap in their review of research in this area that “learners in the learner-centred system have been displaced from the gaze of research”.

When learner-centredness is defined from a research perspective that includes the knowledge base about learning and learners, a foundation is established for building positive learning contexts and communities at the classroom and school levels, thereby increasing the likelihood of success for teachers and learners. This is critical to achieving enhanced teacher quality and increased motivation, learning power and academic

attainment for a significant proportion of learners, including many who are currently or dropping out. It is the *people* along with the *learning process* as an innate and life long experience (Crick *et al.*, 2007:272), that ensure that quality teaching and learning materialize.

If teachers are to be held accountable for their learners' successes and failures, then they should be given the tools and support necessary to bring about effective and successful learning. The notion of learner-centredness also means that teachers, like the learners they teach, must be actively involved in their own learning and change processes, collaboratively with other teachers and experts from higher education institutions (Crick *et al.*, 2007:272).

2.4.5 The national curriculum statement for mathematics

The new South African National Curriculum Statement for Mathematics (NCSM) is specifically focused on the academic stream of FET (schooling grades 10-12) and targets learners who intend to continue with studies in mathematics or who intend to enter into careers in which mathematics is a requirement (Parker, 2006:60). The *National Curriculum Statement (NCS)* for Mathematics (refer to Appendix C, Theme 2) provides a definition of mathematics in the new curriculum that projects an image of mathematics as a *practice*, a “human activity practiced by all cultures” (DOE, 2003a:9). Mathematics, according to Parker (2006:63), is not only a practice, but also a *discipline* in that it is a specialized form with its own unique conventions, symbolism and structure, and a *tool* for problem solving in a variety of contexts including mathematical (abstract problem

solving) and non-mathematical (as applied in issues of public health, finance, or other subjects such as physical sciences).

Mathematics in the NCS curriculum is defined in terms of four learning outcomes (LO's). LO 1: *Number and Number Relationships*; LO 2: *Functions and Algebra*; LO 3: *Space, Shape and Measurement* and LO 4: *Data Handling and Probability*. The intention for each learning outcome is elaborated through assessment standards (AS's) and is supported by further content and context statements (Parker, 2006:63). The content, according to the DOE (2003a:44) must serve the learning outcome, and not be an end in itself, and that suggested contexts will enable the content to be embedded in situations which are meaningful to the learner and so assist learning and teaching.

The planning of the mathematics curriculum in South African schools takes place at different levels namely phase level, grade level and class level, and the principle of designing the curriculum is top-down. This process however, is not strictly linear, but reflexive in nature as teachers may find they are moving backwards and forward in the process as they plan and critically reflect on decisions taken before moving on to the next decision in the process. Phase planning is called a *learning programme* in the General Education and Training (GET) policy documents and a *subject framework* in the Further Education and Training (FET) policy documents, and suggests that the school management makes time available for mathematics teachers to meet together in phase groups to plan for learner development across the phase. Grade planning is the next level which is referred to as the grade-specific work schedule, which is a more detailed

planning tool which focuses on the work to be completed in a particular grade. The last phase is the class level planning which are the lesson plans, developed after the work schedule has been completed, and suggests that each individual mathematics teacher plans for his/her class taking into consideration the needs of the learners.

2.4.6 Assessment of mathematics in grades 10-12

Assessment in mathematics, according to the Subject Assessment Guidelines for Mathematics (DOE, 2008:7), should focus on collecting reliable information regarding learners' mathematical growth and competence, which includes *informal assessment* which informs the teacher how the learners are progressing, *formal internal assessment* which provides the teacher with the means to differentiate between learners on a seven point scale and *external assessment* which occurs in the Grade 12 National Senior Certificate examinations.

The Learning Outcomes and Assessment Standards of the National Curriculum Statement for Mathematics have been divided into Core Assessment Standards for Paper 1 (LO 1 and LO 2) and Paper 2 (LO 3 and LO 4) and Optional Assessment Standards for Paper 3 (LO 3 and LO 4). The purpose of assessing some Assessment Standards as optional, according to the Subject Assessment Guidelines (DOE, 2008:7) is to allow teachers the time to develop their capacity in these Assessment Standards in that they are different as opposed to being more difficult.

2.4.7 Mathematics within the context of national curriculum statement

The Policy Handbook for Educators (ELRC, 2003:H50) defines mathematics as a human activity that involves observing, representing and investigating patterns and quantitative relationships in physical and social phenomena and between mathematical objects themselves. Through this process new mathematical ideas and insights are generated (DOE, 2002:4).

Mathematics uses its own specialized language that involves symbols and notations for describing numerical, geometric and graphical relations. Mathematical concepts build on one another, thereby creating a coherent structure (DOE, 2002:4).

Mathematics, according to the Revised National Curriculum Statement (DOE: 2002:4), is a product of investigation by different cultures and is a purposeful activity in the context of social, political and economic goals and constraints. The Policy Handbook for Educators (ELRC, 2003:H50) states therefore that mathematics is neither value-free nor culturally-neutral.

The teaching and learning of mathematics aims to develop mathematically literate persons to contribute to and participate with confidence in society. The unique features of learning and teaching mathematics include firstly *working with numbers, data, space and shape*, secondly *problem solving techniques* and thirdly *investigating patterns and relationships* (DOE, 2002:5).

2.4.8 Different orientations toward mathematical knowledge

Research by Parker and Adler (2005) argue that the successful implementation of the new curriculum requires internal changes in teachers' orientation to knowledge and meaning, and therefore identity. Parker (2006:60) asks the following question: *What changes in orientation to knowledge and pedagogy are required of South African mathematics teachers by the new curriculum documents?* In order to answer the above question, Parker (2006:60) suggests that a description of the main orientations to knowledge required of mathematics teachers needs to be provided, in an attempt to reveal some aspects of the "bias and focus" of the new curriculum, which was implemented for the first time in grade ten in 2006.

The orientations to mathematical knowledge, according to Gravin's (2002) analysis, gives a description of mathematics in general terms and also provides a general view in terms of its meaning. These orientations, according to the original C2005 curriculum (Parker, 2006:62), are summarized in four different orientations to mathematics in which she mentions: *mathematics for critical citizenship, allowing learners to critique mathematical applications in various social, political and social contexts; mathematics as relevant and applicable to aspects of everyday life and local contexts; mathematics for inducting learners into what it means to be a mathematician, to think mathematically and view the world through a mathematical lens; mathematics involves conventions, skills and algorithms to master in order to gain access to further studies.* Parker (2006:63) also adds a further category which describes: *mathematics as a human activity produced historically in cultural and social contexts.*

According to Parker (2006:65) the majority of the assessment standards indicate some form of orientation towards *mathematics involving conventions, skills and algorithms in order to gain access to further studies*, which is a major focus of the old NATED 550 FET curriculum. There is also a clear focus, according to Parker (2006:65) on applied mathematics as a form of orientation towards *mathematics as relevant and applicable to everyday life and local contexts*. The focus on mathematical practices, as another form of orientation towards *mathematics for inducting learners into what it means to be a mathematician, to think mathematically and view the world through a mathematical lens*, is not understated. The two remaining orientations namely, *mathematics for critical democratic citizenship, with the focus on a commitment on indigenous and mathematics as a human activity produced historically in cultural and social contexts*, according to Parker (2006:65) are not a significant part of the NATED 550 curriculum, and form a focus that would be new to most mathematics teachers, hence illustrating a lack of focus on these orientations in the actual assessment standards.

2.4.9 Integration of the mathematics curriculum

Integration in a curriculum refers to the classification between contents and is thus related to the strength of the boundary *between* different contents (Parker, 2006:66). When the boundary is strong, the contents are well insulated from one another, the ‘voice’ of the subject / discipline dominates and thus classification is strong. There are different types of integration: between subjects / disciplines referred to as *inter-discursive* integration; between different subjects / disciplines (e.g. between mathematics and physical science) referred to as *inter-disciplinary* integration; and within a particular

subject / discipline (e.g. between algebra and geometry as two branches of mathematics), referred to as *intra-disciplinary* integration (Parker, 2006:66).

Integration is not principally aimed at the boundaries between mathematics and non-mathematical discourses (Parker, 2006:66). Rather it seems to broaden the focus of school mathematics learning from entry into a single discipline (pure mathematics) towards a region of the mathematical sciences. The mathematical sciences, according to Parker (2006:66) include the study of mathematics, applied mathematics and mathematical statistics.

There is an emphasis on integration of knowledge, but it is focused mostly on a weakening of boundaries within school mathematics rather than on transfer of knowledge from outside the field of mathematics. For example, the idea of ‘function’ is a key integrating principle that brings together aspects of trigonometry, algebra and calculus. It could be argued that this shows that the field of Mathematics Sciences in the NCSM remains fairly strongly classified in relation to contents outside the field, but there is a weakening of classification values within the field itself. While it appears that the mathematical sciences are fairly well insulated as a field of study, it also appears that relatively strong connections are to be made between the field and local/everyday knowledge, and some connections between the field and other sciences/subjects (Parker, 2006:67).

These relatively strong connections indicate a significant change in the organization of the contents of the NCSM curriculum from that of the old curriculum. In the old curriculum, mathematics as a pure science was insulated from other fields and within the discipline itself, where various topics were also well insulated from one another (Parker, 2006:67).

2.4.10 The context of mathematics and mathematical literacy within the new curriculum statement

The FET curriculum of either Mathematics or Mathematical Literacy involves a clear splitting of the orientations in terms of both presence and emphasis. In crude terms the split in focus occurs largely down the middle with Mathematics focusing on the more tightly bound mathematical orientations 3 and 4 while Mathematical Literacy focuses on the less tightly bound and more utilitarian orientations 1 and 2.

The FET curriculum is designed in such a way that Mathematics and Mathematical Literacy are different “in kind and purpose” (Brombacher, 2007:3) and thus Mathematical Literacy is not subsumed in Mathematics. In Mathematics, as was the case with Mathematics in the previous FET curriculum, a strong mathematical agenda is clear with “rigorous logical reasoning” and “theories of abstract relations” (DOE, 2003a:9) being emphasized. The context of learning is primarily “in the context of mathematics itself” (DOE, 2003a:9). While the definition includes “logical reasoning about problems in the physical and social world” (DOE, 2003a:9) which “enables us to understand the world and make use of that understanding in our daily lives”, an analysis

of the vast amount of content to be covered indicates that this is largely based on the hope that the mathematics content learnt in its abstract form will be understood by learners to use in their daily lives.

Concerns that Mathematics is too abstract, catering primarily to prepare learners to proceed to further mathematically or scientifically oriented studies, can be seen to be addressed by providing an alternative mathematics course for those not needing it for this purpose (i.e. Mathematical Literacy as the alternative). Of course this ‘either / or’ structure, rather than the inclusion of Mathematical Literacy as compulsory for all learners, which means that learners choosing Mathematics, by and large, lose out on learning mathematical ways of ‘acting in the world’ (Steen, 2001:6).

The implication of this is that contexts are the key drivers of learning. The challenge for teachers is to use situations or contexts to reveal the underlying mathematics while simultaneously using mathematics to make sense of the situations or contexts, and in so doing develop in learners the habits or attributes of a mathematically literate person (DOE, 2006:4).

2.4.11 Reform research in mathematics education

Reform research is by definition concerned with *change* and as such the set of questions that reform research must engage with is related to a paradigm shift for teachers, learners, parents, researchers and politicians. The analysis of learners’ views

and perspectives presented are framed against an emerging field of research in mathematics education that may be referred to as reform research.

Reform research that was done by Innabi and El Sheikh (2006:46) on teachers' perceptions on critical thinking, suggested certain curriculum changes which could impact on implementing an effective mathematics curriculum. These curriculum changes include curriculum goals that should lead to the development of mathematical communication skills, logical thinking abilities, creativity and the abilities to discern relations amongst variables. Mathematical learning and instructional techniques, according to this research, should be chosen so as to enhance the creativity and critical thinking skills of learners. It is also suggested by Innabi and El Sheikh (2006:46) that the evaluation of learning by learners should include assessing their ability to apply mathematical knowledge in unfamiliar contexts and to think independently and creatively.

This reform research (Innabi & El Sheikh, 2006) which was done in Jordan is confirming that the pillars for effective curriculum management and curriculum delivery in all mathematics classrooms should be *effective teaching, effective learning and effective assessment practices*.

For effective curriculum management in South African classrooms, all stakeholders in education should realize that learner achievement begins and ends with the quality of the teacher, the instructional programme and good assessment strategies.

Although the lessons and activities that teachers plan, teach and evaluate might not always be perfect, the outcomes of those lessons nevertheless should exhibit *best practices*.

2.4.12 The views of mathematics teachers on a changing curriculum

For most South African teachers, as supported by research done by Naidoo and Parker (2005), the adoption of the new curriculum is a prerequisite for teachers to undergo major changes in their approach to teaching and learning. This research (Naidoo & Parker, 2005) which focused on the analysis of teachers' perspectives on the changing curriculum and assessment practices in Grade 9 mathematics through the implementation of the National Common Task Assessments showed that teachers' existing identities were in contradiction to the new expectations which had major consequences for the aim of mathematics for all concerned.

To monitor the implementation of constructivist teaching methods in South Africa, the *Constructivist Learning Environment Survey* (CLES) (Taylor & Fraser, 1991; Taylor, Dawson & Fraser, 1995; Taylor, Fraser & Fisher, 1997) was developed to provide perspectives of teachers' attempts to transform their classroom learning environments in accordance with the critical constructivist epistemology (Sebela, 2009:2). The CLES, according to Sebela (2009:2) is to enable teachers to monitor the transformation from a more teacher-centred approach to a more constructivist approach, and to address key constraints in developing constructivist teaching climates in science and mathematics classrooms in South Africa. The research by Sebela (2009) was at this

time still ongoing and consequently does not provide deep enough-insight into the transformational aspects. This research suggests that there is no difference between learners doing Curriculum 2005 and those learners who were taught the old curriculum, and also emphasizes that the differences between the teachers' and learners' perceptions about Curriculum 2005 and the NATED 550 curriculum in both cases are not seen significantly.

The role of the mathematics teacher in the mathematics classroom, within a changing curriculum cannot be understated. It is widely accepted that mathematical skills are critically important in our technologically sophisticated world (Van der Walt & Maree, 2007:223), hence highlighting the importance of effective mathematics teaching, learning and assessment. As effective teaching, learning and assessment practices are prerequisites for curriculum implementation, so is the role of the teacher in directing, planning, monitoring, evaluating and reflecting on their own instructional behaviour in order to facilitate the learning process with understanding (Van der Walt & Maree, 2007:223).

The facilitation of mathematics learning is not only a South African problem; it is a cause for concern to countries throughout the world. Mathematics is a gateway subject (“enabling discipline”) to tertiary study, and adequate learning facilitation in mathematics is also of pivotal importance in any country. To enhance the facilitation in mathematics, science and technology teaching, South Africa spent about R30 million on bursaries to 4000 teachers between 2002 and 2006, but the alarming low pass rate in mathematics

dropped even further (Van der Walt & Maree, 2007:223). More attention should be given to the performance in subjects like mathematics, focusing on strategies that should be designed to improve learning outcomes.

2.4.13 Mathematics learners adjusting to the new curriculum

Despite the fact that mathematics is the cornerstone of scientific literacy, many South African learners do not perform adequately in the subject and the adoption of an Outcomes-based Education (OBE) system has not contributed to an improvement in the situation (Maree & Louw, 2007:279). Learners throughout the country find themselves in situations where high demands are made on them in order to process loads of information to master contents and to apply their knowledge and skills in everyday situations (Maree & Erasmus, 2006:1).

The problems that mathematics learners encounter could be the lack of conceptual knowledge, and might have been a consequence of poor teaching, learning and assessment strategies. Mathematics, because of its gatekeeper role for certain courses for further study and certain career prospects in the workplace, is viewed by learners as a key subject in solving a multitude of complex problems. It is for this reason that some learners view mathematics as a difficult subject, within the various disciplines of algebra, trigonometry, geometry and calculus.

Research by Vithal and Gopal (2005:45) reports on the views of Grade 8 learners about new curriculum reforms in South Africa, namely Outcomes-based Education

(OBE) and Curriculum 2005 (C2005) that were introduced into the mathematics classrooms. The research focused on some important design features of curriculum reform, namely: *group work, mathematics and context, learning and teaching materials, assessment strategies and the discourse of curriculum reform*. The learners' views on the main features of the new curriculum seemed to be linked to their teachers' explicit engagement or non-engagement with the new curriculum, and they appear to be aware of the tensions and trade-offs for themselves in the enactment of the new curriculum (Vithal & Gopal, 2005:45).

2.4.14 Envisaged changes to the new curriculum statement

In a statement by the current Minister of Basic Education, Angie Motshekga (2009:1), on the Review of Curriculum, which consists of written and electronic submissions of about 400 teachers' views from all nine provinces, on the implementation of C2005, the following findings and conclusions were presented based on the evidence collected by the nine provinces.

The teachers have identified five areas that need to be considered by the Council of Education Ministers, which was presented in a Draft Report at a Quality Learning and Teaching business breakfast at the Sandton Convention Centre, Johannesburg, South Africa, on October 1, 2009. The meeting according to Motshekga (2009:1), was attended by the Deputy Minister of Basic Education, Enver Surty; Members and Executive Members of Provinces, Representatives of the sponsors for this breakfast, Members of

the business community, Presidents of Educator Trade Unions, Principal and School Governing Body Chairperson of Kliptown Secondary School.

In the Draft Report presented to the meeting, five areas have been identified for redress in order to make the implementation of C2005 more effective. The first area was *the issue of the proliferation of documents and the lack of clarity as well as the confusion as a result of this*. The second issue was *the difficulties that teachers have experienced around the assessment of learners and the lack of requirements, which contributed to the increased workload of teachers*. The third and critical issue *relates to the difficulties that learners have experienced in making a smooth transition from Foundation Phase to Intermediate Phase, citing the late introduction of an Additional Language as a language of teaching and learning as well as the change from a Three Learning Programme in Grade 3 to Learning Areas in Grade 4*. The recommendation that the number of Learning Areas be reduced to six is logical and within reason ensuring a smoother transition from the Foundation Phase to the Intermediate Phase. The fourth issue, *relates to the administrative workload of teachers being unreasonable, which could be significantly used as teaching time*. The reduction in the *requirements for assessment, recording and reporting on learner performance is also proposed, which implies that teachers will need to keep a single teacher file on which work is not duplicated unnecessarily*. It also implies *that teachers will no longer moderate one another's work at time-consuming "cluster meetings"*. Finally, the report makes recommendations in respect of improving the context in which teachers teach, suggesting that teachers should receive more subject-

specific or learning area-specific support from subject advisors, and that subject-specific support should not degenerate into the monitoring of teachers only.

2.4.15 Review of the curriculum on outcomes-based education

The notion that the curriculum could be adjusted was mentioned in May 2000 by the Review Committee on Curriculum 2005 to the then Minister of Education, Professor Kader Asmal (DOE, 2000:15) by stating that “no curriculum, if it is to be a living curriculum is cast in stone”. This statement suggests that there are many ways of implementing outcomes-based education, as there are routes to a curriculum which could enhance effective teaching, learning and assessment practices in South Africa.

The most influential critic of outcomes-based education and C2005 once it started was undoubtedly Jonathan Jansen in his paper ‘Why OBE will Fail’ (Jansen & Christie, 1999; Jansen, 2001). This paper underscored the criticism that outcomes-based education was not working in classrooms. Concerns about the impact of outcomes-based education were mentioned in a Report of the Review Committee on Curriculum 2005 (DOE, 2000:15) stating that “outcomes-based education cannot be equal in unequal conditions”. A number of submissions and reports received by the Review Committee on Curriculum 2005 (DOE, 2000:16) have drawn attention to the conditions affecting effective implementation of outcomes-based education, namely: *resources* (for training and information, instructional materials e.g. textbooks, exercise books, pens and pencils, and departmental support), *infrastructure* (classroom space, desks, electricity, toilets, telephones, fax machines and photocopiers), *conditions for teaching and learning* (large

classes, learner:teacher ratios, diversity of classrooms), local and institutional capacity (staffing, leadership and management of schools, planning and administration), *a will to implement* (readiness of teachers to engage with new ideas and put them into practice), *pressure in the form of policy* (mandated implementation), *support from implementing agencies* (professional development, support and monitoring), *adequate and timeous information, feasible time-frames and participation*.

In a speech in the National Assembly of Parliament, on November 5, 2009, the Minister of Basic Education Angie Motshekga announced dramatic changes on the outcomes-based approach to teaching, learning and assessment in the New Curriculum Statement for all grades (Motshekga, 2009:1). These changes were already envisaged by the previous Minister of Basic Education, Naledi Pandor (Motshekga, 2009:1), who initiated a curriculum review process, after considerable criticism of teacher overload, confusion, stress and a consistent underperformance of South African learners in both local and international assessments.

The problem with an outcomes-based approach in the New Curriculum Statement is ironically the fact that, according to a report by a panel of experts which was appointed in July 2009 to investigate challenges and problems in the New Curriculum Statement, it does not deliver the desired outcomes in terms of learner performance (Motshekga, 2009:1). The changes to the approach to teaching, learning and assessment in the New Curriculum Statement, will take effect from January 2010 (Motshekga, 2009:1). Teachers will be provided with systematic support to strengthen their teaching techniques, and

relieved of administrative burdens that impact on teaching time. A relief of these administrative duties includes a discontinuation of the formal compilation of assessment requirements, because some of these assessment requirements did not add any value, instead they distract both teachers and learners from the core function of the curriculum.

2.4.16 The introduction of a national basic education plan

A ‘back to basics’ approach where reading, writing and arithmetic are prioritized as opposed to a Bill Spady view of time-based subjects and content specific knowledge has been suggested by the Review Committee on Curriculum 2005 (DOE, 2000:15). It was also mentioned in this report (DOE, 2000:15) that both versions are misrepresentations in the manner they are implemented, because they deny the complexity and the differences of a South African society.

The long term plan for the basic education sector in South Africa is known as *Schooling 2025: the Department of Basic Education’s Action Plan* (Motshekga, 2010:2). This long term plan of developing National Curriculum and Assessment Statements is not the development of a new curriculum, but only a refined and repackaged already existing National Curriculum Statement Grades R-12. The Minister of Basic Education, Angie Motshekga (2010:2) established three committees namely: *The Curriculum and Assessment Policy Statements Project Committee*, *The Committee for the Reduction of Learning Areas in the Intermediate Phase in the GET Band*, and *The Learning and Teaching Support Materials Committee* of highly respected experts to enable the smooth implementation of streamlining of the curriculum. On the release of the *Annual National*

Assessment (ANA) Results, Motshekga (2011b:6) called for a delivery-approach to schooling to take forward the processes on initiatives currently implemented, which is guided by the current administration's outcomes approach.

The duties of the Curriculum and Assessment Policy Statements Ministerial Project Committee are to develop a single comprehensive and concise Curriculum and Assessment Policy Statement (CAPS) for each grade, R-12. These Curriculum and Assessment Policy Statements should provide clear guidelines on what ought to be taught and assessed on a grade by grade and subject by subject basis. The duties of the Committee for Reduction of Learning Areas in the Intermediate Phase in the GET Band is to plan for the implementation of the recommended reduction of learning areas in the Intermediate Phase from eight to six. The Learning and Teaching Support Materials Committee is to consider recommendations on improving the distribution and use of Learning and Teaching Support Materials (LTSM) in schools (Motshekga, 2010:2).

The National Department of Education (DOE) now renamed Department of Basic Education (DBE) announced by means of Circular SI of 2010 (Motshekga, 2010:8) that the Grade 9 CTA's are discontinued with immediate effect and that provincial education departments have to determine the form of assessment which will constitute the 25% external component of the Grade 9 promotion mark. The implementation of Annual National Assessments for Grade 3 and Grade 6 in 2010 is, according to Motshekga, (2010:8) geared towards improving the quality of education and the results will inform

the decisions the Department of Basic Education needs to take regarding tracking and improving the quality of learning and teaching in the system.

Part of strengthening of the curriculum statements is a consolidation of the documents, including Lesson Plans in Literacy and Numeracy for Grades 1-6, that have been made available to teachers as part of *Schooling 2025*, to strengthen their teaching capacity. The distribution of workbooks for Grades R-6 focus on literacy and numeracy, and focuses on preparing grades R-6 learners for the annual national assessments (Motshekga, 2010:9)

The Report of the Ministerial Task Team on the Review of the Implementation of the National Curriculum Statement (Motshekga, 2010:9) advised that no further changes to the progression requirements be effected in order to strengthen assessment practices. All schools, according to Motshekga (2010:9), are to use the existing Assessment Policy in the GET phase and the provisions of assessment in the National Policy on the Protocol for Assessment: Reporting and Recording.

The curriculum reforms introduced in the education system is an attempt to restore the confidence and enthusiasm amongst all stakeholders in South Africa, to provide short-term relief to the administrative load of teachers and to do away with the need for portfolio files of learner assessment. These broad recommendations of the Ministerial Project Committee are an attempt to iron out the difficulties that exist in education quickly and efficiently (Motshekga, 2010:2).

2.4.17 Curriculum and Policy Statement (CAPS)

The Ministerial Project Committee consisting of eight people, oversaw the selection of 176 writers which included 28 translators for languages at Home and First Additional Language and 14 translators for languages at Second Additional Language to develop the National Curriculum and Assessment Policy Statements for each grade (Motshekga, 2011a:12). After consultation with all the relevant stakeholders in education, as a final step the Heads of Education Departments and the Council of Education Ministers made their final comments before the Minister of Basic Education declared it as national education policy, hence the CAPS documents were finalized in line with the recommendations made by the 2009 Task Team Report on the Implementation of the National Curriculum Statement (Motshekga, 2011a:13). In addition, UMALUSI, the quality assurance and standardization body for assessment and examinations in South Africa, has quality assured the CAPS documents and put plans together to benchmark them internationally (Motshekga, 2011a:7).

The National Curriculum Statement Grades R-12, implemented during the period 2012-2014 underpins the various programmes followed in each Grade from Grade R- 12 and comprises of: (a) National Curriculum and Assessment Policy Statements for all approved subjects for the Foundation Phase (Grades 1-3), the Intermediate Phase (Grades 4-6), the Senior Phase (Grades 7-9) and the Further Education and Training Phase (Grades 10-12), (b) National Policy pertaining to the programme and promotion requirements of the National Curriculum Statements Grades R-12 and (c) National Protocol for Assessment Grades R-12 (Motshekga, 2011a:8).

After the Minister of Basic Education declared the CAPS document as national education policy, the *National Curriculum Statement Grades R-12* are then promulgated in the Government Gazette and then tabled in Parliament into law.

2.4.18 Curriculum and Policy Statement (CAPS) on mathematics

The National Curriculum Statement Grades R-12 (DOE, 2003a) stipulates policy on curriculum and assessment in the schooling sector. In order to improve its implementation, the National Curriculum Statement (DOE, 2003a) was amended, with the amendments coming into effect in January 2011 (DBE, 2010:1). These amendments, according to the Final Draft of the Curriculum and Assessment Policy Statement (DBE, 2010:1) include a single comprehensive Curriculum and Assessment Policy document developed for each subject to replace the old Subject Statements, Learning Programme Guidelines and Subject Assessment Guidelines in Grades R-12, and as a consequence, is replaced by the National Curriculum and Assessment Policy (CAPS) of 2011, the Revised National Curriculum Statement Grades R-9 (DOE, 2002) and the National Curriculum Statement Grades 10-12 (DOE, 2004).

The Curriculum and Assessment Policy Statement for Mathematics Grades R-12 which defines Mathematics (DBE, 2010:5) redefines mathematics as a study of quantity, structure, space and change, a study that seeks out patterns, formulates new conjectures and establishes axiomatic systems by rigorous deduction from appropriately chosen axioms and definitions, a study that is a distinctly human activity practiced by all

cultures, a study that is about problems. Most of all it is a study that encourages and enhances creative thinking.

The important general principles according to the Curriculum and Policy Statement (DBE, 2010:6-7) which apply across all grades, include: *mathematical modeling* as an important focal point of the curriculum where real life problems should be incorporated into all sections whenever appropriate and the examples used should be realistic and not contrived, *investigations* by which an opportunity to develop in learners the ability to be methodical, to generalize, make conjectures and prove them. Learners need to reflect on the processes and not be concerned about getting the answer/s. *Appropriate approximations and rounding skills* should be taught so that learners understand that all answers which are either irrational or recurring decimals should routinely be given correct to two decimal places. *The inclusion of the history of mathematics* to show mathematics as a human creation which is hotly contested and still developing and *contextual problems* should include issues relating to health, social, economic, cultural, scientific, political and environmental issues. Whenever possible the *how, when and the why* should be taught within a relevant context, because mean and standard deviation of a set of data has little relevance unless learners have a good grasp of why and when such calculations might be useful. *Mixed ability teaching* requires teachers to challenge the most able learners and at the same time provide remedial support for those for whom mathematics is difficult. *Problem solving and cognitive development* should be central to all mathematics teaching, because learning procedures without a

good understanding of why they are important will leave learners ill-equipped to use their knowledge in later life.

2.4.19 Revised assessment of mathematics grades 10-12

The most outstanding feature about the Revised Assessment of Mathematics Grades 10-12 is the phasing out of Paper 3 with the optional content. These optional contents e.g. Probability, Statistics, Regression and Euclidean Geometry have been incorporated in Paper 1(Probability) and Paper 2 (Statistics, Regression and Euclidean Geometry). In order to make provision for this optional content, topics like Linear Programming in Paper 1 and Transformation Geometry in Paper 2 had to be compromised. According to the National Curriculum and Policy Statement (DBE, 2010:56), all the formal assessment tasks have been stipulated for each term, with the exception that the project, investigation or assignment is limited to one of the three assessment activities per year, where 25% is a year mark and 75% an examination mark.

2.4.20 Approval of the national curriculum statement as national policy

The National Curriculum Statement, Grades R-12, was approved, after consultation with the Council of Education Ministers on the 11th September 2011 by the current Minister of Basic Education at the time and was promulgated in the Government Gazette (2011:1) on the 12th September 2011. The National Curriculum Statement, Grades R-12, according to the Government Gazette (2011:1) was approved as National Policy in terms of the National Education Policy Act, 1996 (Act No. 27 of 1996).

The National Curriculum Statement, Grades R-12, consists of the following three documents, namely: the *Curriculum and Assessment Policy Statements* for all approved subjects, the *National Policy Pertaining to the Programme and Promotion Requirements* of the National Curriculum Statement Grades R-12 and the *National Protocol for Assessment Grades R-12* (Government Gazette, 2011:1).

Comparison between the old and amended (new) National Curriculum Statement, as revealed by the Department of Basic Education (2011:13) shows significant differences in terms of the Subject and Policy Statements. The use of national policy documents is to illustrate these differences to be authentic and clear in terms of the principles omitted from and added to the Curriculum and Assessment Policy Statement (CAPS), namely:

The following principles were omitted from the Curriculum and Assessment Policy Statement (CAPS), namely:

Outcomes-Based Education (OBE): setting outcomes, learner-centred and activity based approach to education.

Integration and applied competence: integration of knowledge and skills is crucial for achieving applied competence, namely an integrated learning of theory, practice and reflection.

Articulation and Portability: relationship between qualifications in different National Qualifications Framework (NQF) levels to promote access from one

qualification to another. Portability – parts of a qualification are transferable to another qualification in a different learning pathway of the same NQF level.

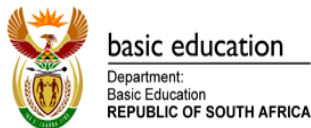
The following principle was added to Curriculum and Policy Statement (CAPS) as shown in the table below:

Active and critical learning: encouraging an active and critical approach to learning, rather than rote and uncritical learning of given truths.

The Curriculum and Policy Statement now consists of SEVEN principles as opposed to the NINE in the old National Curriculum Statement.

Comparison Between Current and Amended NCS

OLD / Current	NEW / Amended
Subject Statement supported by LPG and SAGs	Curriculum and Assessment Policy Statement (CAPS)
<p>Nine principles underpinning curriculum: social transformation; Outcomes-Based education; high knowledge and high skills; integration and applied; competence; progression; articulation and portability; human rights, inclusivity, environmental and social justice; valuing indigenous knowledge systems; and credibility, quality and efficiency.</p>	<p>Seven principles underpinning curriculum: social transformation; high knowledge and high skills; progression; human rights, inclusivity, environmental and social justice; valuing indigenous knowledge systems; credibility, quality and efficiency; and Active and critical learning</p>



(DBE, 2011:13)

The National policy pertaining to the programme and promotion requirements of the NCS according to the Department of Basic Education (2011:14), replaces the following documents of the old National Curriculum Statement:

National Senior Certificate: A qualification at level 4 on the National Qualifications Framework (NQF).

An addendum to the policy document, the National Senior Certificate: A qualification at level 4 on the National Qualifications Framework (NQF), regarding

learners with special needs, published in the Government Gazette, No.29466 of 11 December 2006.

The curriculum language in the National Protocol for Assessment, Grades R-12 have also changed from *Learning Outcomes (LO's) and Assessment Standards (AS's)* in the old National Curriculum Statement (NCS) to *Topics* in the new Curriculum and Assessment Policy Statement (CAPS). The assessment in the old NCS was divided into GET Learning Areas and FET subjects, while the subjects in the new CAPS are assessed across the curriculum, as shown in the table below.

Comparison Between Current and Amended NCS	
OLD / Current	NEW / Amended
The NCS Grades 10 – 12 consists of the Subject Statements and the NSC: A qualification at Level 4 on the NQF.	The NCS Grades R – 12 consists of the CAPS and the policy document, National policy pertaining to the programme and promotion requirements of the NCS Grades R – 12
Learning Outcomes and Assessment Standards.	Topics: concepts, knowledge and skills
GET Learning Areas and FET subjects.	Subjects across the curriculum



The frame of reference for this study primarily deals with the old National Curriculum Statement (NCS), as the amended National Curriculum Statement (CAPS) according to the Government Gazette (2011:1), to be implemented incrementally as follows:

Grade 3 and Grade 10: January 2012

Grade 4 - Grade 6 and Grade 11: January 2013

Grade 5 – Grade 7 and Grade 12: January 2014

The continual change of mathematics curricula since the political transition to a constitutional democracy in 1994 has not impacted positively on the attainment levels in mathematics, of especially learners drawn from previously disadvantaged communities. This study engages the literature in an attempt to contextualize the primary and subordinate questions and to address the challenges faced by both teachers and learners. Although several curriculums have been introduced, as pointed out in the literature, the focus of this study is the *National Curriculum Statement (NCS)* for mathematics, as it was still in use during the time of this study.

2.5 CONCLUSION

Even with a new democratic government presently in place, a new curriculum with an outcomes-based education system of high demands, the consequences of the former apartheid education system in South Africa are still catastrophic and still hamper the career prospects of (especially) black learners (Kahn, 2004:149). The view that the critical skills of literacy and numeracy are fundamental to further education and

achievement in the worlds of both education and work should be strongly emphasized. Many of learners especially in previously disadvantaged schools lack proper foundations in literacy and numeracy and therefore struggle to progress in the system and into post-school education and training (Motshekga, 2011b:1).

The teacher is a key element in ensuring that quality education is delivered to all learners. In a newspaper article *Department already using unqualified staff in critical subjects like maths and science* (Daily Dispatch 2011, October 6), independent education expert Graeme Bloch said that teachers were needed to be acknowledged as the bedrock of the education system. Graeme Bloch in the same newspaper article mentioned that teachers are in the frontline of seeing the problems in the education system, from poor resources, no staff-rooms, poor libraries, to hungry children and unmotivated parents.

It is for this reason that teachers need to be sufficiently trained in the new curriculum, as well as their role to deliver in terms of effective teaching, learning and assessment requirements. By addressing these curriculum challenges, the teacher's role and responsibility to create an enabling teaching and learning environment is pivotal in laying the foundations for quality education.

Learner attainment begins and ends with the quality of the teacher, the effectiveness of the instructional programme (teaching, learning and assessment activities), and the type of leadership of the institution in creating conditions for effective curriculum delivery. In trying to improve learner attainment, school management teams

(SMT's) first need to consider whether teachers are instructionally solid, are they effective in implementing lessons that exhibit best practices and whether they are open to new ideas.

Effective leadership by the principal, the directorship and middle-managers of schools plays an important role in setting up effective instructional programmes. The core business of all instructional leaders is to provide leadership for effective learning, and also to realize that the importance of school leadership is judged by the extent to which they nurture and support effective teaching and learning in the school.

The two most direct ways to influence learner achievement is firstly, to ensure that solid instruction takes place and secondly that learners are served with a curriculum that actually meets their needs. Only when learners see the relevance in the curriculum in terms of their real-life expectations, will they equip themselves with the skills essential to succeed, hence feeling comfortable and confident to achieve success.

A feeling of community and motivation created in the educational setting can lead to learners responding positively to the pacing of the content in the curriculum, the style of the instruction and general atmosphere of the class. When learners are convinced that the efforts of their teachers are genuine in trying to create conditions that are conducive for effective teaching, learning and assessment practices, they will engage in the learning process. Such actions are powerful means of demonstrating interest in increasing learner

motivation, because learners don't care how much teachers know until they know how much teachers care.

The collective effort should be embodied by positive collective efficacy relations by teachers in implementing the curriculum changes, in a manner that is positive and encouraging to the learners. When learners are positively motivated by their teachers, they will combat feelings of apathy, setting their own education expectations and develop their own learning strategies to achieve it, hence organize and manage their time to improve on their own achievement irrespective of the socio-economic challenges.

With the criticism on the outcomes-based approach of the new curriculum, the constant reviews and a poor learner attainment in the critical and core subjects, pressure is exerted on education stakeholders to provide quality education to all learners. It is only through a collective effort by teachers, parents and learners that positive skills, values and attitudes can be developed in the face of introducing and constantly reviewing the new curriculum, without causing confusion and uncertainty.

The challenges that a changing curriculum have brought on principals, school management teams, teachers, parents and learners of schools cannot be understated. In a culture where human rights and democratic values are brought into schools (which are bureaucratic by nature) the challenges for teachers to create conditions for effective learning are much greater.

The teacher therefore is the key to unlocking desires of achievement and success in learners, irrespective of external factors that might impact negatively on learner self-efficacy and the collective efficacy amongst all the other members of the school.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

In this chapter detailed descriptions are provided in terms of the methods used to gather information for this research. The methodology describes the steps followed in the execution of the study and also provides a brief justification for the research methods used (Perry, Carson & Gilmore, 2003:661). This section contains enough detail to enable the reader to evaluate the appropriateness of the methods and the reliability and validity of the findings of the study (Kotze, 2007:44). Research methodologies also enable experienced researchers to replicate one's study (American Psychological Association, 2001:17).

The methodology section also outlines the paradigms of research, research approach, research design, population, sample, methodology, data gathering instruments and data analysis. The data gathering instruments (questionnaires, interviews and mathematics test) are not only described, but also justified in terms of being appropriate and scientifically sound within the context of the type of data collected.

The guidelines of “best practice” that apply to a specific research approach (mainly qualitative in nature) are described (Kotze, 2007:44). The research process considers different paradigms underpinning research traditions, followed by a brief discussion about the notion of paradigms, and then an in-depth discussion of the positivist and interpretive paradigms, the latter embodying the theoretical underpinning on which this study is based.

The research design is described and a research methodology is developed that is reliable and valid in terms of the research questions and sub-questions. The research design examines the effect of collective efficacy on mathematics teachers implementing curriculum changes in mathematics, as it impacts on academic achievement of learners, especially when these curriculum changes are implemented within previously disadvantaged schools.

3.2 RESEARCH PARADIGMS

A paradigm is a model or framework for observation and understanding, which shapes both what we see and how we understand it, therefore forming fundamental frames of reference we use to organize our observations and reasoning (Babbie, 2004:33).

Paradigms, according to Terre Blanche and Durrheim (2002:6), are all encompassing systems of inter-related practice and thinking that define for researchers the nature of their enquiry along three dimensions: *ontology* (the nature of reality that is to be studied), *epistemology* (the relationship between the researcher and what can be

known) and *methodology* (the methods the researcher may use to study what he or she believes can be known).

The three dimensions as illustrated in Table 3.1 (Terre Blanche & Durrheim, 2002:6) constrain each other. If the research topic consists of a stable and unchanging external reality (e.g. economic laws, cognitive mechanisms, the law of gravity), then the researcher can adopt an objective and detached epistemology and use a methodology that relies on control and manipulation of reality.

On the one hand such research would be to provide an accurate description of the laws and mechanisms that operate in social life, which defines a *positivist approach* within the research paradigms. If on the other hand, the researcher believes that the reality to be studied consists of peoples' subjective experiences of the external world, he or she may adopt an inter-subjective or inter-action epistemology and use methodologies (such as interviewing or participant observation) that rely on a subjective relationship between the researcher and the subject. This type of research is characteristic of the *interpretive approach*, which aims to explain the subjective reasons and meanings that lie behind social action (Terre Blanche & Durrheim, 2002:6).

If the researcher believes that reality consists of a fluid and variable set of social constructions, he or she may adopt a suspicious or politicized epistemology, and employ methodologies that allow the researcher to deconstruct versions of reality. This type of research, which is not applicable to this study, is characteristic of a *constructionist*

approach, which aims to show how versions of the social world are produced in discourse, and to demonstrate how these constructions of reality make certain actions possible and others unthinkable (Terre Blanche & Durrheim, 2002:6).

Each of the paradigms offers different frames of reference to observe and to make sense of human social life. Babbie (2004:35) also noted that each paradigm makes certain assumptions about the nature of social reality; each paradigm opens new understandings, suggests different kinds of theories, and inspires different kinds of research.

A discussion on only the interpretive and positivist paradigms follows as only these two paradigms embody the theoretical framework of this study. The reason for the interpretive paradigm is that the study consists of teachers' perceptions and perspectives, for the positivist paradigm is that social sciences research is best validated by scientific inquiry. A discussion on the constructionist paradigm is therefore omitted, because this study does not use a politicized epistemology neither does the researcher endeavour to deconstruct reality.

Table 3.1: Positivist, Interpretive and Constructionist Paradigms

	Ontology	Epistemology	Methodology
<i>Positivist</i>	Stable external reality Law- like	Objective Detached observer	Experimental Quantitative Hypothesis testing
<i>Interpretive</i>	Internal reality of subjective experience	Empathetic Observer inter-subjectivity	Interactional Interpretive Qualitative
<i>Constructionist</i>	Socially constructed Reality Discourse	Suspicious Political Observer constructing versions	Deconstruction Textual analysis Discourse analysis

(Terre Blanche & Durrheim, 2002:6)

3.2.1 Interpretive paradigm

The interpretive paradigm, according to Babbie and Mouton (2010:643) is the meta-theory which in opposition to positivism, and is based on the assumption that

human phenomena are fundamentally distinct from natural phenomena. Some of the critical differences refer to the inherent *meaning-creating* nature of human behaviour and the historicity of all human actions, which require methods that are very different from those used in natural phenomena (Babbie & Mouton, 2010:643). In general it implies that one aims at interpreting or understanding human behaviour, rather than explaining or predicting it.

The interpretive approach, according to (Terre Blanche & Kelly, 2002:123) assumes that people's subjective experiences are real and should be taken seriously (ontology), in that we understand others' experiences by interacting with them and listening to what they tell us (epistemology), and that qualitative research techniques are best suited to this task (methodology). While the positivist paradigm relies on objectivity, the interpretive paradigm attempts to understand reality through interpretation of the world around it. Babbie (2004:87) notes that social research can serve many purposes, amongst others to *explore*, to *describe* and to *explain*. Qualitative social research has always been judged on the standard of whether the work "communicates to us", based on how we conceptualize our reality and our images of the world (Denzin & Lincoln, 2000:11).

The quality of the research in the interpretive paradigm depends mainly on the nature and the quality of the interaction between the researcher and the respondent, because the working hypothesis in a given context is best verified and confirmed by the people who inhabit that context, the respondents. Respondents, who are probed within an

interpretive paradigm, are therefore in a better position to *interpret* and *understand* complex mutual interactions and also to *respond* to influences of value patterns on human behaviour. The respondents, as inhabitants of a given context, will then translate their experience of reality, not by means of variables and mathematical formulae as characterized by a positivist approach, but through an interpretive approach which attempts to use the power of ordinary *language and expression*, to help us better understand the social world we live in (Terre Blanche & Kelly, 2002: 123). Qualitative researchers are more likely to confront and come up against the constraints of the everyday social world, hence seeing this world in action and embedding their findings in it (Denzin & Lincoln, 2000:10).

Qualitative findings may be presented alone or in combination with quantitative data (Patton, 2001:4), hence implying that research and evaluation studies employing multiple methods, including combinations of qualitative and quantitative data, are common. An example of such multiple methods, as it applies for this study is a questionnaire or interview that asks both fixed-choice (closed) questions and open-ended questions, which is an example of how quantitative measurement and qualitative inquiry are combined.

This study is guided in mainly the interpretive paradigm, with some quantitative methods as required in a quantitative paradigm. The reason for this approach is that qualitative studies attempt to get close to the research subjects in their natural setting in order to describe and understand the world through their eyes (the insider perspective),

while quantitative methods in data collection and data analysis assist in conforming ethnographic social research to standard logic. Although a mainly qualitative approach in this study is adopted with some help from some quantitative methods, refer Neuman (2006:150) to the combination of paradigms as triangulation of theory, when a researcher uses multiple theoretical perspectives in the planning stages of research, or when data is interpreted. Multiple kinds of knowledge which is produced by multiple epistemologies and methodologies are not only worth having, but also demanded if policy, legislation and practice are to be sensitive to social needs (Lincoln & Cannella, 2004:7).

3.2.2 Positivist paradigm

A positivist approach adopts the view that the world is stable and measureable, and believes that symbolic systems – including language and numbers can accurately represent reality, and that this representation can be objective (Durrheim, 2002b:77). Positivism, according to Morrow (2002:2), is the dominant framework of thinking in our world, and its convictions are seen by many educated people as common sense. This fact is illustrated by the “prestige” that science enjoys in the world as the most reliable kind of knowledge, contrary to the widespread belief that a debate about “values” cannot be argued rationally, be it religious, moral or any other kind of value (Morrow, 2002:2).

According to the positivist view, it is possible to represent reality through technical means by using measurement, and that objectivity is believed to be achievable. Durrheim (2002b:77) suggests that the main objective is for researchers to be sure that the numbers they use to represent reality correspond with the nature of attributes being

measured. This process is achieved, according to (Durrheim, 2002b:77-91) by *conceptualization* (developing a clear, explicit and specific definition of the attribute being measured), *operationalization* (developing a clear and concise plan to measure the attribute empirically), *validity* (the degree of measurement between the conceptual and operational definition of the construct) and *reliability* (the dependability of the measurement instrument, that is the extent to which the instrument yields the same results on repeated trials).

3.3 RESEARCH APPROACH

3.3.1 Qualitative research approach

Qualitative research approaches include strategies such as ethnographies, case studies, interviews, observations, document analysis and discourse analysis. Qualitative analysis of data involves the application of *priori* or emergent codes to facilitate interpretation for meaning (Hart, Smith, Swars & Smith, 2009:29).

The research design for this study entails a qualitative ethnographic study into the insider world of mathematics teachers, implementing curriculum changes in mathematics. Babbie and Mouton (2010:279) define ethnography as the data of cultural anthropology that is derived from direct observation of behaviour in a particular society, hence concluding that rather studying people, ethnography means learning from people. Ethnography is the earliest distinct tradition of qualitative inquiry, which takes as its central and guiding assumption that any human group of people interacting together for a

period of time will evolve a culture (Patton, 2001:81). Three of the most common and useful purposes of ethnographic social research are exploration, description and explanation (Babbie, 2004:87). The purpose of social research for this study is exploratory in nature as it is an attempt to satisfy the researcher's curiosity and desire for better understanding about the topic.

A large proportion of social research is conducted to explore a topic, or to provide a basic familiarity with that topic (Babbie & Mouton, 2010:79). Exploratory studies are commonly used, according to Wisker (2001:120), when new knowledge is sought or new behaviour and the causes for the presentations of symptoms, actions, or events need discovering e.g. exploratory research would ask more about the locations of schools, their intake, class size, staff/learner ratio and so on and how those variables affect the achievement of learners. Another major aim of exploratory studies, according to Babbie and Mouton (2010: 81) is to indicate relationships between events, which apply to this study, where the effect of collective efficacy on mathematics teachers is investigated and the impact it has on effective curriculum implementation in mathematics, and eventually on the academic achievement of mathematics learners.

It is for this reason that social research emphasizes trustworthiness as a parallel idea to objective standards in quantitative research design, to ensure that the research is dependable and credible (Neuman, 2006:153). For interpretive researchers, the goal of social research is to develop an understanding of social life, and to discover how people construct meaning in their natural settings (Neuman, 2006:88). Qualitative ethnographic

social research, according to Denzin and Lincoln (2000:38) entails an attitude of attachment toward society that permits the sociologist to observe the conduct of self and others, to understand the mechanisms of social processes, and to comprehend and explain why both actors and processes are as they are.

The major characteristics of qualitative research therefore include induction, discovery, exploration and a theory or hypothesis generation, with the researcher as the primary instrument of data collection and qualitative analysis (Hart *et al.*, 2009:29).

3.3.2 Quantitative research approach

Hart *et al.* (2009:28) refer to the definition of Gall, Borg and Gall (1996:767) of quantitative research as an inquiry that is grounded in the assumption that features of the social environment constitute an objective reality that is relatively constant across time and settings. The dominant methodology of quantitative research is to describe and explain features of this reality by collecting numerical data on observable behaviours of samples and by subjecting these data to statistical analysis.

Hart, *et al.* (2009:28) mention that in quantitative data collection the instruments that are used result directly in numerical data, typically from experimental designs (e.g. random pretest-posttest), quasi-experimental designs (e.g. randomization), meta-analysis, or non-experimental designs (e.g. surveys). The type of quantitative approach for this study is a non-experimental survey in the form of questionnaires to be conducted on both mathematics and non-mathematics teachers in the sample schools where they teach.

3.4 RESEARCH DESIGN

A research design, according to Babbie and Mouton (2010:72) addresses the planning of scientific inquiry, in other words designing a strategy for finding out something. Tredoux (2002:311) also agrees and states that a research design is a plan or protocol for a particular piece of research which includes the elements (e.g. variables, participants), their interrelationship and methods (e.g. sampling, measurement) which constitute the piece of research. The research design for this study therefore provides a blueprint for aspects of research in terms of procedures adopted to determine the method of sampling, data collection and analysis.

3.4.1 Mixed method research design

Silver (2004:154) claims that in the discipline of mathematics education, researchers have “erected a monument to qualitative research methods and non-experimental modes of inquiry during the past few decades”. According to a study by the National Council of Teachers of Mathematics Research Advisory Committee (2003) in the past several years politicians, policy makers and significant funding agencies in the United States have been calling for evidence-based educational practices and scientific inquiry that provides results that can be generalized more widely, typically involving quantitative results.

Several researchers namely Demerath (2006), Schoenfeld (2007) and others are now at the view that pragmatism necessitates a move toward research that allows for a

variety of methods to be mixed in various ways to address complex research questions. Similarly Tashakkori and Teddlie (2003:ix-x) indicate that “an examination of recent social and behavioural research reveals that mixed methods are being used extensively to solve practical research problems”.

Tashakkori and Teddlie (2003:711) provide Creswell’s (2003) definition of mixed methods as a “collection or analysis of both quantitative and qualitative data in a single study in which data are collected concurrently or sequentially, are given priority, and involve integration of the data at one or more stages in the process of research”. However Moghaddam, Walker and Harre (2003:113) claim that the prevailing approach for labeling mixed methods studies “has been to distinguish between quantitative and qualitative methods and [then] to define any study that incorporates both. Johnson, Onwuegbuzie and Turner (2007:129) led them to conclude, in part, that mixed methods is an intellectual and practical synthesis based on qualitative and quantitative research that relies on qualitative and quantitative viewpoints, data collection, analysis, and inference techniques combined according to the logic of mixed methods research to address one’s research question(s).

The design for this study adopts Creswell’s (2003) definition as the collection or analysis of quantitative and qualitative data in a single study in which data are collected concurrently or sequentially. The manner in which the data were collected and analyzed for this study is sequential, by which the quantitative data were collected and analyzed

first which is then followed by the collection and analysis of the qualitative data in order to combine certain aspects of the data.

The primary aim of qualitative studies, as it applies to this study is to explore socially constructed events, while quantitative studies are more accurate and precise in describing causal relationships between variables (Babbie, 2004:89), hence complementing each other in terms of data collection and data analysis. This study investigates the effect of collective efficacy on mathematics teachers implementing a new curriculum in schools situated in previously disadvantaged communities, including the academic achievement in mathematics of learners in these schools using a combination of numeric and textual data as primary data. The data collection instruments include a combination of quantitative and qualitative data collection techniques, namely questionnaires and interviews for teachers and mathematics tests for learners. The distinction between qualitative and quantitative data in social research is essentially the distinction between non-numerical and numerical data (Babbie, 2004:26).

3.4.2 Exploratory sequential design

An exploratory sequential design is selected to achieve a more comprehensive, elaborated and nuanced view (Creswell, Plano Clark, Gutman & Hanson, 2003) of the effect of collective efficacy on effective curriculum implementation. The quantitative component provided estimates of the effect of collective efficacy on both mathematics and non-mathematics teachers and the impact it has on effective curriculum implementation. The qualitative component, with its inductive theoretical drive (Morse,

2003), generated insights on the perceptions and perspectives of only mathematics teachers in relation to effective curriculum implementation and consequently academic achievement of mathematics learners.

The use of quantitative data is consistent with the sequential exploratory design, in which the quantitative component assists in the interpretation of the qualitative findings (Creswell *et al.*, 2003). The integration of findings from both phases adds to our understanding of the effect of collective efficacy on both mathematics and non-mathematics teachers of the whole school, and subsequently the effect it has on mathematics teachers implementing a new curriculum in mathematics.

The quantitative component in the form of existing quantitative instruments (questionnaires) as indicators of the effect of collective efficacy on both mathematics and non-mathematics teachers of the whole school, providing a comparison base with which to compare the perceptions and perspectives of the mathematics teachers in the qualitative component (interviews) that the new curriculum is teachable, over and above the socio-economic surroundings of the school. The mathematics test for learners is also a quantitative (multiple-choice test) instrument which is used as a measure to triangulate the qualitative data by supplementing transcripts of structured interviews with mathematics teachers in the sample schools.

3.4.3 Qualitative research design

The research design for this study is mainly based on the ethnographic qualitative research approach, using interviews as qualitative data collection methods and theme analysis of the interviews as data analysis techniques to give some perspective into the inside world of the research participants.

This study favours a qualitative research design even if both qualitative and quantitative methods are adopted, because the social context in which the research takes place involves social attributes of teachers. Qualitative research stresses the socially constructed nature of reality, the intimate relationship between the researcher and what is studied, and the situational constraints that shape inquiry (Denzin & Lincoln, 2005:10).

The first step in qualitative interpretation is to learn about its meaning for the people being studied who create social behaviour due to personal reasons (or motives) for their actions (Neuman, 2006:160). This study is an investigation about perceptions and perspectives of mathematics teachers in relation to implementing curriculum changes in mathematics, which requires a qualitative approach to provide personal insight, feelings and human perspectives to understand the topic under discussion.

Ethnographic qualitative research studies provide high construct validity, because it provides in-depth insight about the research participants and the phenomena that are studied, and also provide a rapport with the research participants (Mouton, 2004:148). The limitation of ethnographic qualitative research is the incapacity to generalize the

results. Ethnographic qualitative research also lacks the standardization of measurement, and data collection and analysis can be very time consuming (Mouton, 2004:148).

3.4.4 Quantitative research design

Research, however is by nature scientific and requires instruments and techniques that address the issue of integrity and validity. It is for this reason that quantitative methods are used in the form of precise statements, standard techniques and statistics in the data collection and data analysis for this study.

The quantitative nature of the research for this study is a non-experimental design in the form of a survey, whereby questionnaires were used to probe questions to both mathematics and non-mathematics teachers of the sample schools relating to the first two sub-questions. The survey for this study is of an inductive and a-theoretical nature. Survey research, according to Babbie and Mouton (2010:230), is perhaps the most frequently used research design in the social sciences, and also excellent vehicles for measuring attitudes and orientations in a large population. Mouton (2004:152) describes surveys as studies that are usually quantitative in nature and which aim to provide a broad overview of a representative sample of a large population. In a typical survey, the researcher selects a sample of respondents and administers a standardized questionnaire to them (Babbie & Mouton, 2010:231). Survey research, according to Babbie and Mouton (2010:232), is probably the best method available to the social scientist interested in collecting original data for describing a population too large to observe directly.

The strengths of surveys is that it has the potential to generalize to large populations if appropriate sampling design has been implemented, high measurement reliability if proper questionnaire construction and high construct validity if proper controls have been implemented (Mouton, 2004:153). The limitations of surveys is that they lack insider perspective which sometimes leads to “surface level” analysis and survey data are sometimes very sample and context specific, especially with public opinion polls (Mouton, 2004:153), which is not the case with this study.

With the help of quantitative methods, mathematical and statistical methods are used. The strength of these types of methods is that they increase the generalization of results in social science research. The limitations are the moderate inability to infer causality, because of the social nature of the study (Mouton, 2004:158).

3.5 POPULATION

The population is the term used to describe the group or collection in order to make generalizations (Babbie, 2004:190). The population for this study is defined as all mathematics teachers and learners who find themselves in secondary schools, which are situated in previously disadvantaged communities in the Eastern Cape, South Africa. The target population is that aggregation of elements from which the sample is actually selected (Babbie, 2004:190). The target population consists of mathematics teachers and learners of secondary schools, situated in previously disadvantaged communities, in the East London District, in the Eastern Cape of South Africa, and who are subjected to curriculum changes under challenging socio-economic conditions.

3.6 SAMPLE

Social research that requires non-probability sampling is often conducted as it also applies to this study. According to Babbie (2004:182), non-probability sampling is any technique used in which samples are selected in some way not suggested by probability theory which requires large-scale social surveys. A specific technique of non-probability sampling for this study will be purposive (judgmental) sampling. A reason for this choice is that purposive sampling should, according to Patton (2001:245), be judged according to the purpose and rationale of the study, and not according to the utility and credibility of small samples. The sample therefore must be judged in context as it applies to all aspects of qualitative inquiry, the same principle that undergirds analysis and presentation of qualitative data (Patton, 2001:245).

Purposive sampling as a technique of non-probability sampling is a valuable kind of sampling for specific situations (Neuman, 2006:222). Purposive sampling is appropriate to select unique cases that are informative where the researcher can make use of qualitative inquiry to investigate certain themes. Another use for purposive sampling occurs when a researcher wants to identify particular cases for in-depth investigation in order to gain a deeper understanding of the subjects and their worlds (Neuman, 2006:222). Purposive sampling, according to Babbie (2004:183) is appropriate to select a sample on the basis of the type of the population in terms of their knowledge, its elements and the purpose of the study. The validity, meaningfulness, and insights generated from qualitative inquiry have more to do with information richness of cases selected and the

observational/analytical capabilities of the researcher rather than with sample size (Patton, 2001:245).

The sample for this study is selected on the basis of the knowledge that the research participants have in the particular cases being probed. The participants are mathematics and non-mathematics teachers who have already dealt with instruction through new curriculum content as the curriculum was changing, and the mathematics learners who through observation have seen the changes in the content and its taxonomy. These teachers and learners, because of socio-economic surroundings in which their schools are located, have insight into how those conditions are influencing effective teaching, learning and assessment practices at their respective schools.

The sample schools have been selected on the basis of their similar quintile accreditation by the Department of Education, in terms of financial and resource constraints. Each Provincial Education Department assigns a poverty score to each school which is based on the relative poverty score of the community around the school. This assessment also includes national data, as conducted by the national Census (Statistics South Africa, 2001). The variables for this assessment, which is done every five years, include the following: household or individual income of the community in the school's attachment area, dependency ratio (the proportion of income earners to people who are dependent), or unemployment rates and level of education in the community. The schools are then divided into five quintiles from quintile one (poorest) to quintile five (least poor).

The schools that have been selected have all quintile ratings below five, which require substantial financial and resource support from the Department of Education due to socio-economic constraints. In a newspaper article *School funding change on cards for June* (Daily Dispatch 2011, April 29), the spokesperson for the National Department of Basic Education, Granville Whittle outlines the funding model for all public schools in South Africa, according to their quintile status. The funding model, according to the article, mentions that quintile one schools receive R980 per child per year, quintile two schools receive R880 per child per year, quintile three schools receive R880 per child per year, quintile four schools receive R480 per child and quintile five schools receive R165 per child. These schools are situated in previously disadvantaged communities which include some of the Indian, Coloured and Black residential areas in East London, in the Eastern Cape of South Africa.

All the schools that have been chosen for this study are located within the East London District of the Eastern Cape Department of Education. The sample schools have been given pseudonyms in order to comply with the ethical requirements for social research. The sample schools are referred to as School A, which is located in an Indian residential area, School B, which is located in a Coloured residential area and School C, which is located in a Black residential area. All the schools mentioned above have below five quintile accreditations from the Eastern Cape Department of Education.

The research is conducted *firstly* on all the teachers who are teaching in the sample schools, *secondly* on all mathematics teachers in the sample schools, *thirdly* on

mathematics teachers who are teaching the grade eleven learners in the sample schools, and *finally* grade twelve mathematics learners in the sample schools who have already completed the grade eleven work schedule.

Data collection instruments in the form of questionnaires for teachers and a mathematics test for learners, which are quantitative in nature, together with interviews which are qualitative in nature, have been used in an effort to gather evidence on the effect of collective efficacy of the relevant learning institutions on effective teaching, learning and assessment strategies of the new curriculum. The type of the data collected is analyzed both quantitatively and qualitatively, but interpreted quantitatively within the social context of perceptions and perspectives of the mathematics teachers, teaching in schools situated in previously disadvantaged communities.

The sample for this study is as follows:

- All teachers (mathematics and non-mathematics teachers, $n = 100$) completed a Likert scale questionnaire (refer to Appendix A), consisting of statements with multiple performance indicators ranging from strongly disagree (= 1) to strongly agree (= 5).
- A sample of mathematics teachers ($n = 16$) completed a questionnaire (refer to Appendix B) by which the participants were asked to respond to a series of statements, indicating the statements of their preference.
- A sample of grade eleven mathematics teachers ($n = 6$) was interviewed (refer to Appendix C) to give input and further clarify the effect of collective efficacy on the

implementation of a new curriculum which consequently influences the academic achievement of learners in mathematics.

- A sample of grade twelve mathematics learners ($n = 100$) completed a mathematics test (refer to Appendix D). The test with a maximum of 35 marks was moderated and validated by the Department of Education, Eastern Cape (refer to Appendices E and F). The test consists of questions with multiple answers whereby the learners made their choice of preference.

3.7 METHODOLOGY

Qualitative research, as a set of interpretive activities, privileges no single methodological practice over another (Denzin & Lincoln, 2005:6), nor does qualitative research have distinct sets of methods or practices that are entirely its own (Denzin & Lincoln, 2005:7). The methodology of this study is aligned with the research objectives/research sub-questions in terms of the type of data, source of data, method of data collection, procedure and method of data analysis.

3.7.1 Surveys

Durrheim (2002b:73) states that objects are things in the world e.g. brains, individuals, societies, cultures etc. have attributes, which are particular features an object may have along various dimensions. When the attributes of individuals are measured such as intelligence, height or personality, numbers are assigned to objects to represent how much the object has of a particular attribute (Durrheim, 2002b:73). The process for

assigning numbers should be explicitly stated, as it is the case with a Likert scale questionnaire in this study, or generally agreed upon by the scientific community where these numbers are standardized (Durrheim, 2002b:73).

Surveys, according to Babbie and Mouton (2010:232), are chiefly used in studies that have individual people as the unit of analysis. Survey research is probably the best method, according to Babbie and Mouton (2010:232), available to the social scientist in collecting original data for describing a population too large to observe directly. Surveys are also excellent vehicles for measuring attitudes and orientations in a large population. If you can summarize the attitude in a fairly brief statement, you can present that statement and ask the respondent whether they agree or disagree with it (Babbie & Mouton, 2010:232). Rensis Likert has greatly formalized this procedure through the creation of the Likert scale, a format in which respondents are asked to strongly disagree, disagree, neither disagree nor agree, agree or strongly disagree (Babbie & Mouton, 2010:233).

With regard to the first sub-question: *To what extent does collective efficacy in the schools affect the perceptions and perspectives of both mathematics and non-mathematics teachers that curriculum changes could be implemented effectively in the schools where they teach?*, the data required include perceptions and perspectives of teachers. The categories in this questionnaire include *the effectiveness of the school, the attitude of the learners, classroom practice, teaching and learning strategies, professional development and support, and leadership and management*. The sample

includes all the teachers, including both mathematics and non-mathematics teachers of the sample schools. The data collection instrument that was used with regard to the sub-question is a baseline questionnaire for all the teachers at the school (refer to Appendix A). The precise statements and the numerical values allocated to the responses of the statements i.e. strongly disagree = 1, disagree = 2, neither disagree nor agree = 3, agree = 4 and strongly agree = 5 are gathered by using a spreadsheet (refer to Appendix A1), and requires a statistical approach to the analysis of the questionnaires, which was done by the Unit for Statistical Consultation at the Nelson Mandela Metropolitan University (refer to the first sub-question in the template in Table 3.2).

3.7.2 Questionnaires

Questionnaires are data collection instruments that deal with variables in social research and are used widely in experiments, evaluation research and other data collection activities (Babbie & Mouton, 2010:239).

This questionnaire deals with self-efficacy beliefs of mathematics teachers in terms of their individual beliefs regarding effective teaching, learning and assessment strategies in mathematics. The process of assigning numbers in the questionnaire in this study depends on the preference of a particular statement and is also consistent with the use of questionnaires in previous social research, Rose and Medway (1981:185) as a case in point. The research design is a questionnaire which is predominantly descriptive in nature and the mode of reasoning is more inductive and a-theoretical, because it points to either positive or negative beliefs of mathematics teachers. The use of a questionnaire

where numbers are assigned explicitly in a questionnaire with +1 allocated for a belief that is within the teacher's control (internal control = 1) and -1 for a belief that is outside the teacher's control (external control = 0), requires a quantitative approach to data collection and data analysis.

With regard to the second sub-question: *To what extent does collective efficacy affect the management of these curriculum changes which includes the effectiveness of teaching, learning and assessment strategies, which mathematics teachers are implementing?*, the data required are also quantitative in nature, because the data dealt with the effectiveness of mathematics teachers to bring about effective teaching, learning and assessment in the classroom. The sample included all the mathematics teachers in the sample schools. A questionnaire was designed in a manner to collect data regarding effectiveness of mathematics teachers in terms of effective teaching, learning and assessment strategies. The sample for this set of data included all mathematics teachers at the sample schools. The questionnaire dealt with statements of preference (refer to Appendix B), whereby (depending on the preferred statements) positive or negative numerical values are allocated. The data, because of the allocation of numerical values to the statements were gathered on a spreadsheet (refer to Appendix B2), and analyzed by the Unit for Statistical Consultation at the Nelson Mandela Metropolitan University (refer to the second sub-question in the template in Table 3.2).

3.7.3 Semi-structured interviews and mathematics test

With regard to the third sub-question: *To what extent does mathematics efficacy affect mathematics teachers and learners in terms of effective teaching and learning strategies, which consequently lead to the academic achievement of learners?*, the data required are both qualitative and quantitative in nature. The qualitative data were collected through interview questions from grade eleven mathematics teachers, which probed teachers on the effect of mathematics efficacy on both mathematics teachers and learners, and the views of these teachers on effective teaching and learning practices (refer to Appendix C). The interviews are recorded on one audio digital disk and then transcribed into prose text (refer to Appendix C3). The quantitative data were collected through a mathematics test which included thirty five mathematical statements, in which the learners indicated their choice or preference (refer to Appendix D). Only one answer out of four possibilities is correct, and a numerical value (+1) is allocated when the preferred choice is correct or subtracted (-1) when the preferred choice is incorrect. The qualitative statements of the interviews were analyzed according to the themes in the data, and the quantitative data of the mathematics test were gathered on spreadsheet (refer to Appendix D4), and were analyzed statistically by the Unit for Statistical Consultation at the Nelson Mandela Metropolitan University (refer to the third sub-question in the template in Table 3.2).

Table 3.2: A template whereby the research methodology is aligned with the research objectives / sub-questions.

RESEARCH QUESTION	Sub-QUESTION	Type of data required (quantitative / qualitative / mixed method)	Source of data (population and sample)	Method of data collection (instruments and procedures)	Method of data analysis
To what extent does collective efficacy in the schools affect the perceptions and perspectives of all teachers, both mathematics teachers and non-mathematics teachers, that the curriculum changes could be implemented effectively?		Quantitative (perceptions and perspectives of teachers).	Sample – all teachers, both mathematics and non-mathematics teachers of the sample schools.	Survey (non-experimental design) Instrument is a baseline questionnaire (Likert scale questionnaire adapted from Keele University, England); 1=strongly disagree, 2= agree 3= neither disagree nor agree 4= agree 5= strongly agree	Descriptive statistics. Statistical analysis done by the Unit of Statistical Analysis, NMMU
To what extent does collective efficacy affect the management of these curriculum changes which include the effectiveness of teaching, learning and assessment strategies in mathematics, which mathematics teachers are implementing?		Quantitative (mathematics teachers' beliefs about their effectiveness of teaching, learning & assessment strategies)	Sample – all mathematics teachers in sample schools.	Instrument is a questionnaire (adapted from Rose & Medway, 1981) – statements of preference with positive/ negative numerical values allocated.	Descriptive statistics. Statistical analysis done by the Unit of Statistical Analysis, NMMU
(a)To what extent does mathematics efficacy affect mathematics teachers and learners		Qualitative data(self-belief issues on effective teaching	(a)Interviews for qualitative data	Grade 11 Math teachers for qualitative data.	Themes in interviews for qualitative data.

<p>in terms of effective teaching and learning strategies, (b) which lead to a better conceptual understanding of mathematics , and consequently to better academic achievements by learners?</p>	<p>& learning practices) & Quantitative data</p>	<p>(b) Maths test on Gr. 11 content for quantitative data</p>	<p>Gr.12 mathematics learners– statements of preference with numerical values allocated</p>	<p>Descriptive statistics. Statistical analysis done by the Unit for Statistical Consultation, NMMU for quantitative data.</p>
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3.8 DATA GATHERING INSTRUMENTS

The data gathering instruments for this study include three tools namely questionnaires and interviews with teachers, and a mathematics test for grade twelve learners who have completed all the prescribed learning outcomes and assessment standards in grade eleven.

3.8.1 Questionnaires

Although the term *questionnaire* suggests a collection of questions, an examination of a typical questionnaire will probably reveal as many statements as questions (Babbie & Mouton, 2010:233). The reason why the researcher is using statements is to determine to what extent the research participants hold a particular perception or perspective. Rensis Likert has, according to Babbie & Mouton (2010:233) greatly formalized the Likert scale, a format in which respondents are asked to strongly disagree, disagree, neither disagree nor agree, agree or strongly agree.

The baseline questionnaire to address the first sub-question (refer to Appendix A) is a collective efficacy questionnaire for all the teachers, which includes both mathematics and non-mathematics teachers at the sample schools. This questionnaire is adapted from survey guidelines used by the Research Institute for Public Policy and Management at Keele University, England to survey learners, parents, teachers and support staff. The questionnaire focuses on teachers' attitudes towards their professional experience. It examines teachers' perceptions about aspects of school life which influences the quality of their experiences, including their views on the behaviour and attitude of learners, their relationship with learners, the range and style of their teaching, their perception of the professional support they receive and their level of job satisfaction. The questionnaire consists of twenty five statements of which the participants have indicated their choices of preference, ranging from responses from strongly disagree, disagree, neither disagree nor agree, agree and strongly agree.

The questionnaire for all the mathematics teachers in the sample schools (refer to Appendix B), which addresses the second sub-question, focuses on the self-beliefs of mathematics teachers that they can bring effective change in terms of instructional strategies and classroom management practices in the schools where they teach. The questionnaire is adapted from research done by Rose and Medway (1981:185) and comprises twenty-five statements of which the participants indicated their choice of preference between two statements. Positive or negative numerical values are allocated to different statements of choice, and the questionnaire is analyzed in relation to the baseline collective efficacy questionnaire in order to draw comparative analysis between

collective efficacy of the whole school and the attitudes, perceptions and perspectives of the mathematics teachers in the classroom. Durrheim (2002b:93) claims that most measures in behavioural sciences (e.g. IQ scores, scores on attitude scales and knowledge tests) are considered interval scores, and in addition to performing mathematical relations ($<$, $>$), mathematical operations of addition and subtraction ($+$, $-$) may be legitimately operated.

3.8.2 Semi-structured interviews for mathematics teachers

The purpose of a research interview is first and foremost to gather data, not to change people (Patton, 2001:405). Interviewing is one of the most common and powerful ways in which we try to understand our fellow humans (Denzin & Lincoln, 2005:697). The interview can be structured, semi-structured (as is the case with this study) or unstructured. Interviews according to Denzin and Lincoln (2005:698) can be used for the purpose of measurement, or its scope can be the understanding of an individual or a group perspective. Qualitative researchers are realizing that interviews are not neutral tools of data gathering, but rather active interactions between two (or more) people leading to negotiated, contextually based results (Denzin & Lincoln, 2005:698).

In a structured interview the interviewer asks all the respondents the same series of questions (Denzin & Lincoln, 2005:702), while in an unstructured interview the conversation is rich in gathering feelings and could go off the point, because the unstructured interview follows the thought and the discussion processes of the interviewee (Wisker, 2001:168). Semi-structured, open-ended interviews manage to

address the need for comparable responses that is, the same questions are being asked for each interviewee, as well as the need for the interview to be developed by the conversation between the interviewer and the interviewee, which is often rich and rewarding. With the semi-structured interview, open-ended interview, according to Wisker (2001:168), there is a set series of questions to be asked and space is allowed for some divergence, with the interviewer then returning to the structured interview questions.

The semi-structured interview consists of structured questions asked, but allows space for the interviewee to give in-depth explanations on some of the issues. All the responses from the research participants are then recorded according to a coding scheme. In a semi-structured interview, all the research participants receive the same set of questions asked in the same order or sequence, with a little flexibility in the manner questions are asked or answered. The combination of structured and unstructured questions in a semi-structured interview makes a combination of thin descriptions (structured interview) and thick in-depth descriptions (unstructured interview) possible. For this study there are about twelve questions by which the respondents are probed in a manner which illicit specific responses, and also to give respondents some flexibility to elaborate or give in-depth explanations to some of the interview questions.

The purpose of the interview for this study, which addresses partly the third sub-question, is to illicit responses from mathematics teachers who teach in schools situated in previously disadvantaged communities, in order to gauge the level of their

mathematics efficacy beliefs to bring about effective teaching, learning and assessment strategies in the new curriculum. The questions for the interview were prepared in advance and focus on three themes in terms of effective teaching and learning methodologies, namely *teachers' understanding of the concept of outcomes-based education, teachers' understanding of a new curriculum statement in mathematics and teachers' expositions in the schools where they teach* (refer to Appendix C). All the mathematics teachers teaching in the sample schools were asked the same questions in the same sequence, with some flexibility where certain conceptual issues were probed, and their responses were analyzed and interpreted according to themes in a coding scheme.

3.8.3 Mathematics test for grade twelve learners

A mathematics test was administered to grade twelve mathematics learners who have completed the entire grade eleven content. The mathematics test includes the core Assessment Standards as is indicated in the Subject Assessment Guidelines for Mathematics, Gr10-12 (DOE, 2007b:7). The mathematics test includes all aspects of the work, and the degree of difficulty of the questions complies with the taxonomy as prescribed by the Subject Assessment Guidelines for Mathematics, Gr10-12 (DOE, 2007b:12). The degree of difficulty of the questions ranges from questions that require basic mathematical knowledge, routine procedures, complex procedures and problem solving techniques, which guides taxonomical differentiation of questions on National Grade Twelve question papers for the National Senior Certificate Examination.

The mathematics test for the grade twelve learners that assesses grade eleven work is important, because the grade eleven content does not only form the basis for conceptual understanding of the core assessment standards in grade twelve, but the grade twelve final question paper also consists of between 35% to 40% of grade eleven content. The National Senior Certification process, according to the Subject Assessment Guidelines for Mathematics, Gr10-12 (DOE, 2005:11) includes a formal assessment at the end of grade twelve, whereby the external mathematics assessment assesses the Assessment Standards of grades eleven and twelve, assuming that learners have achieved the grade ten Assessment Standards.

The results for mathematics for grade twelve for the three sample schools as released by the East London District, Eastern Cape for the November 2010 Final Examination read as follows: School A registered 23 learners for Mathematics whereby 17 learners passed and only 3 learners achieved between 50-69 percent and no learner achieved above 80 percent. School B registered 49 learners for Mathematics, whereby only 25 learners passed and only 6 learners achieved between 50-79 percent and no learner achieved above 80 percent. School C registered 50 learners for Mathematics, whereby only 17 passed and only 4 learners achieved between 50-79 percent and 1 learner achieved above 80 percent.

The reason for assessing grade twelve mathematics learners on grade eleven content is to assess for both conceptual understanding and conceptual difficulties in certain areas of mathematics. The mathematics test was written by one hundred grade

twelve learners of three sample schools. The test was written at the sample schools under controlled conditions, which were supervised by the researcher and the respective mathematics teachers. The test included thirty five statements with four multiple answers and cover the core disciplines in the grade eleven work schedule. The core disciplines were clearly sequenced starting with Algebra with fifteen statements, Trigonometry consisting of seven statements, Analytical Geometry with five statements, Transformation Geometry with three statements, Data Handling with four statements and Surface Area and Volume with one statement only. The questions for the mathematics test (refer to Appendix D) as well as the memorandum (refer to Appendix E) were moderated externally by the Eastern Cape Department of Education. A report from the internal moderator for mathematics from the Eastern Cape on the coverage of the Learning Outcomes and the Assessment Standards of the thirty five statements is attached (refer to Appendix F).

3.9 DATA ANALYSIS

Data analysis for this study is a combination of quantitative and qualitative techniques. Quantitative techniques employ a variety of statistical analysis to make sense of data, whereas qualitative techniques identify themes in the data and relationships between the data (Durrhiem, 2002a:47). The findings and the interpretation of the collected data is done with a qualitative approach to the main and sub-questions of the research as collective efficacy issues such as perceptions and perspectives of mathematics teachers are probed.

3.9.1 Survey and questionnaire

Descriptive statistics is a method for presenting quantitative descriptions in a manageable form (Babbie & Mouton, 2010:459), as is the case with this study where a description of association connects one variable with another sort. Selecting the appropriate measure of association for any study, according to Babbie and Mouton (2010:460) depends on the nature of the variables. The association between any two variables provides all the information needed to determine the nature and extent of the relationship between collective efficacy and effective curriculum implementation, as it applies to this study.

Quantitative analysis is done by computer programmes, which are able to read the data that was collected during the research (Babbie, 2004:396). The statistical approach using STATISTICA computer software used descriptive statistics in the form of *multi-item analysis* which uses a Cronbach alpha coefficient for internal consistency in the analysis of the quantitative data.

3.9.2 Semi-structured interviews for mathematics teachers

The data analysis of the interview starts while the interview is still underway, because the preliminary analysis guides you to redesign your questions to focus on the central theme of the research (Mouton, 2004:198). After the interview is completed, a more detailed analysis is embarked on to discover additional themes and concepts in order to get a broader understanding of the issues at hand. The data are then categorized

according to the themes in order to make comparisons and to discover connections in meanings. The goal is to integrate themes and concepts into theory that offers accurate, detailed and subtle interpretation of the research question, and ultimately sharing that interpretation for understanding the social world (Babbie & Mouton: 2010:199).

Babbie & Mouton (2010:503) suggest computer software namely Computer-Aided Qualitative Data Analysis Software or CAQDAS, which consists of a range of software packages designed to help analyze data which were gathered with the use of qualitative research methods. With CAQDAS, according to Babbie and Mouton (2010:503), the data are better organized, the texts are stored more carefully and no pages of transcribed interviews get lost. In one of the software packages ATLAS.ti, which has the most user-friendly interface, the researcher can orientate him or herself better in terms of the entire research project and not only on the available qualitative data and the consequent stories that stem from them (Babbie & Mouton: 2010:504).

3.9.3 Mathematics test for grade twelve learners

A spreadsheet of the mathematics learners together with their responses (Appendix D4) was sent to the Statistical Unit at the Nelson Mandela Metropolitan University for analysis. The analysis was done in conjunction with the collective efficacy questionnaire for all the teachers of the sample schools, the self-efficacy questionnaire for all the mathematics teachers and the interviews with the grade eleven mathematics teachers. The results of the data collected are presented as tables, graphs and text.

3.10 CONCLUSION

Mixed methods research is undertaken in a wide range of fields, such as education, psychology, social sciences and health sciences. The acceptance of this approach, levels of understanding, and ways in which methods are combined, may differ by the research field. From the study of research in mathematics education, according to Hart *et al.* (2009:39), it is clear that researchers have been mixing qualitative and quantitative methods in various ways, and mixed method studies have been present in varying but substantial numbers in prominent research journals.

The strengths and the limitations of the data collection and data analysis techniques, within a mixed method approach for this study, are outlined. Although both a quantitative and qualitative approach in data collection and analysis is adopted, the findings of the study are summarized qualitatively, because it provides an in-depth description of the research topic under review.

CHAPTER FOUR

DATA PRESENTATION, DISCUSSION AND ANALYSIS

4.1 INTRODUCTION

The numerical data generated are presented in this chapter as, tables, graphs and text. The data generated from the interviews are presented as tape recordings in digital format in the form of one compact audio disc and transcribed as text (refer to Appendix C3). The demographic data of the participants that are described in chapter one and chapter three; the collective, teacher self-efficacy scores, as well as the learner test scores are presented as descriptive statistics, using STATISTICA software.

The consistency of the results of the statistical analyses of the data using Cronbach's alpha reliability (internal consistency) tests, are also presented. The interview data are presented and analyzed in the coherent categories that revealed themselves during the inspection and analysis process used in this study.

The names of the sample schools referred to in chapter three are still consistent with this chapter, by referring to the sample schools as School A, School B and School C, in order to adhere to the ethical considerations which accompany this research. The

ethical principle of *confidentiality* is applied to the sample schools as educational institutions during the analysis and interpretation process of the quantitative data, and also to the grade eleven mathematics teachers during the inspection and analysis process of the semi-structured interviews for the qualitative data (Terre Blanche & Durrheim, 2002:66 - 69).

4.2 CONSISTENCY OF THE DATA

4.2.1 Collective efficacy (CE)

The data on collective efficacy were collected using a Likert-scale questionnaire (refer to Appendix A), whereby both mathematics and non-mathematics teachers had to score twenty five statements grouped into six categories, using a range from 1= (strongly disagree) to 5= (strongly agree). The data collected amongst all the teachers (n = 100), (refer to Appendix A1) in the sample schools across six categories are consistent with Cronbach's alpha Reliability (Internal Consistency), which use item analysis to calculate a consistency coefficient. The Cronbach alpha coefficient, according to Cohen, Manion and Morrison (2007:506) is a measure of internal consistency among multi-item scales, which ranges between 0 and 1. Bryman and Cramer (1990:71) suggest that the reliability level in terms of Cronbach's alpha coefficient is acceptable at 0,8 although others suggest that it is acceptable at 0,67. Cohen *et al.* (2007:506) suggest the following reliability levels: less than 0,60 as unacceptably low reliability, 0,60 - 0,69 as marginally reliable, 0,70 - 0,79 as reliable, 0,80 - 0,90 as highly reliable and greater than 0,90 as very reliable. Five of the six categories in this study rendered coefficients greater than 0,8, except

Category 4 (CE4), most probably because there were only two statements in this category. Table 4.1 shows the Cronbach's alpha scores for internal consistency across all six categories amongst all the teachers of the sample schools. The scores give an indication of the consistency of how all the teachers have scored the Likert-scale instrument e.g. if a teacher scored low on issues in one category, he/she scored low on similar issues raised in other categories and *vice versa*, hence contradictions in the data were non-existent.

Table 4.1: Cronbach's alpha scores for the Collective efficacy (CE) Categories

Collective efficacy categories	Cronbach's alpha
CE1	0.91
CE2	0.84
CE3	0.88
CE4	0.55
CE5	0.83
CE6	0.92

4.2.2 Teacher self-efficacy (TSE)

The data were collected from all the mathematics teachers of the sample schools in the form of a questionnaire where the teachers had to indicate their preference between two options (refer to Appendix B). The data collected amongst all the mathematics teachers of the sample schools (refer to Appendix B2) show a Cronbach's alpha Reliability (Internal Consistency) score of 0,68 very close to 0,7, which according to Cohen *et al.* (2007:506) is Cronbach's alpha benchmark for

internal consistency. The 0,68 score could be argued to show marginal consistency, according to Cohen *et al.* (2007:506), taking into consideration the sample size (n = 16), and the preference of choice (items) was limited to two options (internal control = 1 and external control = 0).

Table 4.2: Cronbach’s alpha scores for the Teacher Self-Efficacy (TSE) Category

Teacher self-efficacy	Cronbach’s alpha
TSE	0.68

4.2.3 Semi-structured interviews

The interviews (refer to Appendix C) were conducted with six mathematics teachers (n = 6) of the sample schools and who have taught the NCS grade eleven mathematics curriculum, in order to get insight into their respective worlds about the challenges that they face in terms of their self-efficacy beliefs regarding their teaching, learning and assessment strategies. The interviews have focused on three themes, namely; Theme 1: *Teachers’ understanding of the concept of outcomes-based education*, Theme 2: *Teachers’ understanding of a new curriculum statement in mathematics*, Theme 3: *Teachers’ expositions of mathematics in the schools where they teach*. Voice recordings have been made of the interviews and have been saved in digital format on one compact audio disk and then *verbatim* transcribed (refer to Appendix C3). Two interviews with mathematics teachers per sample school have been voice-recorded and transcribed in the sequence of School A (n = 2), School B (n = 2) and finally School C (n = 2).

4.2.4 Mathematics test (Maths)

The data were collected from the grade twelve mathematics learners of the sample schools ($n = 100$) regarding their conceptual understanding of the grade eleven NCS curriculum in the form of a test with multiple answers (refer to Appendix D), which probe the learners' mathematical knowledge across six mathematical categories. The data collected amongst the learners of the sample schools (refer to Appendix D4) give a Cronbach's alpha score of 0,60, which according to Cohen *et al.* (2007:506) could be argued that the multi-items show marginal internal consistency, taking into consideration that the probability of choosing the correct answer is $\frac{1}{4}$ or 0,25. The categories also have different statement allocations e.g. the Algebra Category (Alg) has fifteen statements as opposed to the Surface Area and Volume Category (SAV) with only one statement. These scores below indicate that the mathematics learners of the sample schools were more consistent when answering the Algebra category (Alg) of fifteen statements with a Cronbach's alpha score of 0,60 and less consistent in the other categories, most probably because the statements were fewer e.g. Trigonometry (Trig) 0,40 with seven statements, Analytical Geometry (AnGeo) 0,35 with five statements, Transformation Geometry (TrGeo) 0,30 with three statements, Data Handling (Data) 0,26 with five statements and Surface Area and Volume (SAV) with no score as this category had only one statement. The Cronbach alpha coefficient is only used for multi-item scales (Cohen *et al.*, 2007:506), hence the no score in SAV. The low Cronbach alpha scores in the other respective mathematical categories show unacceptable low reliability which is less than 0,60 (Cohen *et al.*, 2007:506), as the mathematics learners could also have shown a lack of consistency in choosing the correct option within some of these categories.

Table 4.3: Cronbach’s alpha scores for the Mathematical (Maths) Categories

Mathematical categories	Cronbach’s alpha
Alg	0.60
Trig	0.40
AnGeo	0.35
TrGeo	0.30
Data	0.26
SAV	-
Maths	0.60

4.3 DESCRIPTIVE STATISTICS OF COLLECTIVE EFFICACY (CE)

4.3.1 CE of all the teachers (n = 100)

The data for the Collective Efficacy of all the teachers of the sample schools (n = 100) were collected on a spreadsheet per school (refer to Appendix A1). The three schools for the Collective Efficacy (CE) questionnaire include School A (n = 32), School B (n = 36) and School C (n = 32). The data were analyzed by the Unit for Statistical Consultation at the Nelson Mandela Metropolitan University by using item analysis, and the data below give the responses of the twenty five statements (CE1.1 to CE6.5) scored by all the teachers of the sample schools.

Table 4.4: Descriptive Statistics: CE1.1 to CE6.5 (n = 100)

	Strongly disagree		Disagree		Neither		Agree		Strongly agree	
CE1.1	6	6%	27	27%	28	28%	26	26%	13	13%
CE1.2	9	9%	23	23%	31	31%	26	26%	11	11%
CE1.3	13	13%	27	27%	29	29%	23	23%	8	8%
CE1.4	13	13%	43	43%	18	18%	24	24%	2	2%

CE1.5	21	21%	21	21%	23	23%	27	27%	8	8%
CE2.1	24	24%	39	39%	23	23%	12	12%	2	2%
CE2.2	16	16%	37	37%	26	26%	19	19%	2	2%
CE2.3	3	3%	23	23%	27	27%	45	45%	2	2%
CE2.4	12	12%	26	26%	30	30%	29	29%	3	3%
CE2.5	7	7%	29	29%	26	26%	27	27%	11	11%
CE3.1	11	11%	21	21%	33	33%	28	28%	7	7%
CE3.2	4	4%	24	24%	30	30%	34	34%	8	8%
CE3.3	7	7%	33	33%	30	30%	25	25%	5	5%
CE3.4	4	4%	15	15%	39	39%	34	34%	8	8%
CE3.5	3	3%	19	19%	30	30%	40	40%	8	8%
CE4.1	4	4%	29	29%	27	27%	36	36%	4	4%
CE4.2	18	18%	27	27%	22	22%	19	19%	14	14%
CE5.1	8	8%	24	24%	27	27%	36	36%	5	5%
CE5.2	10	10%	18	18%	27	27%	38	38%	7	7%
CE5.3	12	12%	17	17%	36	36%	28	28%	7	7%
CE6.1	9	9%	29	29%	23	23%	36	36%	3	3%
CE6.2	10	10%	28	28%	31	31%	25	25%	6	6%
CE6.3	15	15%	27	27%	29	29%	25	25%	4	4%
CE6.4	14	14%	25	25%	27	27%	25	25%	9	9%
CE6.5	26	26%	33	33%	22	22%	13	13%	6	6%

The data were further condensed into the categories to see in which of the categories the teachers were more efficacious and in which of the categories less efficacious. Table 4.5 summarizes the categories in that order. The teachers who have completed the questionnaire scored on average the highest in Category 3, which is Classroom Practice, with a mean of 3,13 and a standard deviation (S.D) of 0,84, while Category 6, which is Leadership and Management reflected on average the lowest score with a mean 2,78 and a standard deviation (S.D) of 0,98.

The data were reduced from five groups to three groups, as summarized in Table 4.5. The scores on the questionnaire (refer to Appendix A) are as follows; 1 = strongly

disagree, 2 = disagree, 3 = undecided, 4 = agree and 5 = strongly agree. The three groups now covered a lower interval, a middle interval and an upper interval. The lower interval of strongly disagree and disagree are condensed to *disagree* (negative), now include the range between the minimum value and the median (1,0 - 2,6) as the negative responses are to the left of the median. The middle range or the *undecided* column represents the range between the median and the upper quartile (2,6 – 3,4) which renders a middle value of 3, which was the score indicated on the questionnaire for *neither disagree nor agree*. The upper interval (3,4 – 5,0) now includes the range between the upper quartile and the maximum value which includes the two groups of agree and strongly agree and is now referred to as *agree* (positive) as these values tend to lie to the positive side of the upper quartile in the grouped data.

The category in which all the teachers scored most positively is Category 4 (Teaching, Learning and Assessment) with 39%, and the category where the teachers scored most negatively is Category 4 (Teaching, Learning and Assessment) and Category 6 (Leadership and Management) with 43% each, and the category where the teachers were most undecided is Category 2 (The Attitude of the Learners) with 44%. In Category 1 (The Effectiveness of the School) and Category 2 (The Attitude of the Learners), the responses were overall more positive (3,4 – 5,0), and all the negative responses (1,0 – 2,6) fall within the other four categories. The teachers therefore scored positively in only two categories and negatively in four categories, and were most undecided (2,6 – 3,4) in Category 2 (The Attitude of the Learners) and Category 3 (Classroom Practice). The mean scores for all the categories scored by all the teachers of the sample schools is

above 2,60 considering that the minimum score is 1 and the maximum score is 5. The teachers of the sample schools therefore score on average *more positively* on all categories as scores 1 and 2 are on the negative side of the scale.

Table 4.5: Descriptive statistics in descending order: CE1 to CE6 (n = 100)

	Mean	S.D.	[1.0 - 2.6]		[2.6 - 3.4]		[3.4 - 5.0]	
CE3	3.13	0.84	23	23%	41	41%	36	36%
CE5	3.07	0.94	26	26%	37	37%	37	37%
CE4	2.96	0.97	43	43%	18	18%	39	39%
CE1	2.89	0.99	36	36%	34	34%	30	30%
CE2	2.79	0.81	37	37%	44	44%	19	19%
CE6	2.78	0.98	43	43%	27	27%	30	30%

The grouped data for all the teachers in Table 4.6 also suggest that Category 3 (Classroom Practice) has the highest median (Q_2) of 3,00 with a 0,40 difference to the lower quartile (Q_1) of 2,60 and a difference of 0,60 to the upper quartile (Q_3) of 3,60, which implies that the data is slightly positively skewed to the right with a difference of 0,20. The category with one of the lowest medians is Category 2 (The Attitude of the Learners) with Q_2 equal to 2,80 with a difference of 0,65 to the lower quartile (Q_1) and a difference of 0,60 to the upper quartile (Q_3), which implies that the data is slightly negatively skewed to the left with a difference of 0,05. The data in the rest of the other categories are more or less symmetrical with small differences in their ranges to both sides of the median to both the lower quartile (Q_1) and the upper quartile (Q_3). The analysis of the grouped data therefore shows close similarity with the ungrouped data as the median and the mean are very close respectively, which suggests that the teachers of

all the sample schools were *collectively more positive* than negative in terms of their collective efficacy beliefs.

Table 4.6: Descriptive statistics: CE1 to CE6 - All Schools

	CE1	CE2	CE3	CE4	CE5	CE6
N	100	100	100	100	100	100
Mean	2.89	2.79	3.13	2.96	3.07	2.78
S.D.	0.99	0.81	0.84	0.97	0.94	0.98
Minimum	1.00	1.00	1.20	1.00	1.00	1.00
Quartile 1	2.15	2.15	2.60	2.00	2.33	2.00
Median	2.80	2.80	3.00	3.00	3.00	2.80
Quartile 3	3.60	3.40	3.60	3.50	3.67	3.60
Maximum	5.00	4.60	5.00	5.00	5.00	5.00

4.3.2 CE of all the teachers in School A (n = 32)

The descriptive statistics for Collective Efficacy (CE) for School A is presented in the Table 4.7. The table shows that the teachers at School A scored on average the highest in Category 3, which is Classroom Practice with a mean of 3,28 and a standard deviation of 0,65, while Category 2, which is The Attitude of the Learners scored on average the lowest with a mean of 2,74 and a standard deviation (S.D) of 0,61.

The category in which all the teachers scored most positively is Category 3 (Classroom Practice) with 38%, the category where the teachers scored most negatively is Category 4 (Teaching, Learning and Assessment) with 44%, and the category where the teachers were most undecided is Category 2 (The Attitude of the Learners) with 59%. In categories where the responses were overall more positive (3,4 – 5,0), are Category 3

(Classroom Practice) and Category 5 (Professional Development and Support), and all the negative responses (1,0 – 2,6) fall within the other four categories. The teachers therefore scored positively in only two categories and negatively in four categories, and were more undecided (2,6 – 3,4) in Category 2 (The Attitude of the Learners) and Category 5 (Professional Development and Support). The mean scores for all the categories scored by all the teachers of School A is 2,85 considering that the minimum score is 1 and the maximum score is 5. The teachers of School A therefore score on average *more positively* on all the categories as scores are equal or greater than 2,60 are on the positive side of the scale.

Table 4.7: Descriptive statistics: CE1 to CE6 - School [A] (n = 32)

	Mean	S.D.	[1.0 - 2.6]		[2.6 - 3.4]		[3.4 - 5.0]	
CE1	2.85	0.92	12	38%	11	34%	9	28%
CE2	2.74	0.61	10	31%	19	59%	3	9%
CE3	3.28	0.65	5	16%	15	47%	12	38%
CE4	2.98	0.88	14	44%	8	25%	10	31%
CE5	3.24	0.62	4	13%	17	53%	11	34%
CE6	2.89	0.83	9	28%	15	47%	8	25%

The grouped data for the teachers of School A in Table 4.8 also suggest that Category 3 (Classroom Practice) has the highest median (Q_2) of 3,40 with a 0,60 difference to the lower quartile (Q_1) of 2,80 and a difference of 0,20 to the upper quartile (Q_3) of 3,60, which implies that the data is slightly negatively skewed to the right with a difference of 0,20. The category with one of the lower medians is Category 2 (The Attitude of the Learners) with Q_2 equal to 2,80 with a difference of 0,40 to the lower quartile (Q_1) of 2,40 and a difference of 0,45 to the upper quartile (Q_3), which implies

that the data are also negatively skewed to the left with a slight difference of 0,05. The data in the rest of the other categories are more or less symmetrical or slightly positively skewed with small differences in their ranges to both sides of the median to both the lower quartile (Q_1) and the upper quartile (Q_3). The analysis of the grouped data therefore shows close similarity with the ungrouped data as the median and the mean are equal or greater than 2,60, which suggests that the teachers of School A were *collectively more positive* than negative in terms of their collective efficacy beliefs.

Table 4.8: Descriptive statistics: CE1 to CE6 - School [A]

	CE1	CE2	CE3	CE4	CE5	CE6
N	32	32	32	32	32	32
Mean	2.85	2.74	3.28	2.98	3.24	2.89
S.D.	0.92	0.61	0.65	0.88	0.62	0.83
Minimum	1.00	1.60	2.40	1.50	1.67	1.40
Quartile 1	2.20	2.40	2.80	2.50	3.00	2.35
Median	2.60	2.80	3.40	3.00	3.17	2.90
Quartile 3	3.60	3.25	3.60	3.50	3.67	3.45
Maximum	4.60	3.80	5.00	5.00	4.33	5.00

4.3.3 CE of all the teachers in School B (n = 36)

The descriptive statistics for Collective Efficacy (CE) for School B is presented in Table 4.9. The table shows that the teachers at School B scored on average the highest in Category 5 which is Professional Development and Support with a mean of 2,51 and a standard deviation of 1,03, while Category 6, which is Leadership and Management scored on average the lowest with a mean of 2,11 and a standard deviation (S.D) of 0,80. The category in which all the teachers scored most positively is Category 4 (Teaching,

Learning and Assessment) with 22%, and the category where the teachers scored most negatively is Category 6 (Leadership and Management) with 78%, and the category where the teachers were most undecided is Category 3 (Classroom Practice) with 50%. In categories where the responses were overall more positive (3,4 – 5,0) were 0%, because the teachers scored negatively (1,0 – 2,6) 100% in all six categories. The teachers therefore scored positively in none of the categories and negatively in all six categories, and were most undecided (2,6 – 3,4) in Category 3 (Classroom Practice) and Category 5 (Professional Development and Support). The mean scores for most of the categories scored by all the teachers of the sample schools is 2,22 considering that the minimum score is 1 and the maximum score is 5. The teachers of the sample schools therefore score on average *more negatively* as scores less than 2,60 are on the negative side of the scale.

Table 4.9: Descriptive statistics: CE1 to CE6 - School [B] (n = 36)

	Mean	S.D.	[1.0 - 2.6]		[2.6 - 3.4]		[3.4 - 5.0]	
CE1	2.22	0.72	23	64%	11	31%	2	6%
CE2	2.26	0.65	23	64%	13	36%	0	0%
CE3	2.50	0.67	16	44%	18	50%	2	6%
CE4	2.47	0.95	23	64%	5	14%	8	22%
CE5	2.51	1.03	19	53%	10	28%	7	19%
CE6	2.11	0.80	28	78%	5	14%	3	8%

The grouped data of the teachers of School B in Table 4.10 suggest that Category 5 (Professional Development and Support) has the highest median (Q_2) of 2,33 with a 0,66 difference to the lower quartile (Q_1) of 1,67 and a difference of 0,67 to the upper quartile (Q_3) of 3,00, which implies that the data are slightly positively skewed to the

right with a difference of 0,01 or even symmetrical. The category with one the lowest medians is Category 6 (Leadership and Management) with Q_2 equal to 2,00 with a difference of 0,40 to the lower quartile (Q_1) of 1.60 and a difference of 0,40 to the upper quartile (Q_3) of 2.40, which implies that the data are evenly spread around the median or symmetrical. The data in the rest of the other categories are more or less symmetrical or slightly spread to the left with small differences in their ranges to both sides of the median to both the lower quartile (Q_1) and the upper quartile (Q_3). The analysis of the grouped data therefore shows close similarity with the ungrouped data as the median and the mean scores are respectively in most categories less than 2,60 which suggests that the teachers of School B were *collectively more negative* than positive in terms of their collective efficacy beliefs.

Table 4.10: Descriptive statistics: CE1 to CE6 - School [B]

	CE1	CE2	CE3	CE4	CE5	CE6
N	36	36	36	36	36	36
Mean	2.22	2.26	2.50	2.47	2.51	2.11
S.D.	0.72	0.65	0.67	0.95	1.03	0.80
Minimum	1.00	1.00	1.20	1.00	1.00	1.00
Quartile 1	1.60	1.60	2.15	1.88	1.67	1.60
Median	2.10	2.20	2.60	2.25	2.33	2.00
Quartile 3	2.65	2.80	2.85	3.00	3.00	2.40
Maximum	4.00	3.40	4.20	4.50	5.00	4.60

4.3.4 CE of all the teachers in School C (n = 32)

The descriptive statistics for Collective Efficacy (CE) for School C is presented in the Table 4.11. The table shows that the teachers at School C scored on average the highest in Category 3 which is Classroom Practice with a mean of 3,68 and a standard deviation (S.D) of 0,72 and Category 1, which is the Effectiveness of the School with a mean of 3,68 and a standard deviation (S.D) of 0,73, while Category 2, which is the Attitude of the Learners scored on average the lowest with a mean of 3,43 and Category 6 which is Leadership and Management with mean of 3,43 and a standard deviation (S.D) of 0,83. The category in which all the teachers scored most positively is Category 3 (Classroom Practice) with 69%, and the category where the teachers scored most negatively is Category 4 (Teaching, Learning and Assessment) and Category 6 (Leadership and Management) with 19% respectively, and the category where the teachers were most undecided is Category 1 (The Effectiveness of the School) and Category 2 (The Attitude of the Learners) with 38% respectively. In categories where the responses were overall more negative (1,0 – 2,6) were 0%, because the teachers scored positively (3,4 – 5,0) 100% in all six categories. The teachers therefore scored negatively in none of the categories and positively in all six categories, and were a little undecided (2,6 – 3,4) in Category 1 (The Effectiveness of the School) and Category 2 (The Attitude of the Learners). The mean scores for all the categories scored by all the teachers of School C is 3,68 considering that the minimum score is 1 and the maximum score is 5. The teachers of School C therefore score on average *more positively* on all categories as scores are equal or greater than 2,60 which are on the positive side of the scale.

Table 4.11: Descriptive statistics: CE1 to CE6 - School [C] (n = 32)

	Mean	S.D.	[1.0-2.6]		[2.6-3.4]		[3.4-5.0]	
CE1	3.68	0.73	1	3%	12	38%	19	59%
CE2	3.43	0.70	4	13%	12	38%	16	50%
CE3	3.68	0.72	2	6%	8	25%	22	69%
CE4	3.47	0.81	6	19%	5	16%	21	66%
CE5	3.53	0.81	3	9%	10	31%	19	59%
CE6	3.43	0.83	6	19%	7	22%	19	59%

The grouped data for the teachers of School C in the Table 4.12 also suggest that Category 3 (Classroom Practice) has the highest median (Q_2) of 3,70 with a 0,55 difference to the lower quartile (Q_1) of 3,15 and a difference of 0,50 to the upper quartile (Q_3) of 4,20 which implies that the data are slightly negatively skewed to the left with a difference of 0,05. The category with one of the lowest medians is Category 2 (The Attitude of the Learners) with Q_2 equal to 3,50 with a difference of 0,40 to the lower quartile (Q_1) of 3,10 and a difference of 0,60 to the upper quartile (Q_3) of 0,50 which implies that the data are slightly positively skewed to the right with a difference of 0,20. The data in the rest of the other categories are more or less symmetrical with small differences in their ranges to both sides of the median to both the lower quartile (Q_1) and the upper quartile (Q_3). The analysis of the grouped data therefore shows close similarity with the ungrouped data as the median and the mean scores are respectively greater than 2,60 which suggests that the teachers of School C were *collectively more positive* than negative in terms of their collective efficacy beliefs.

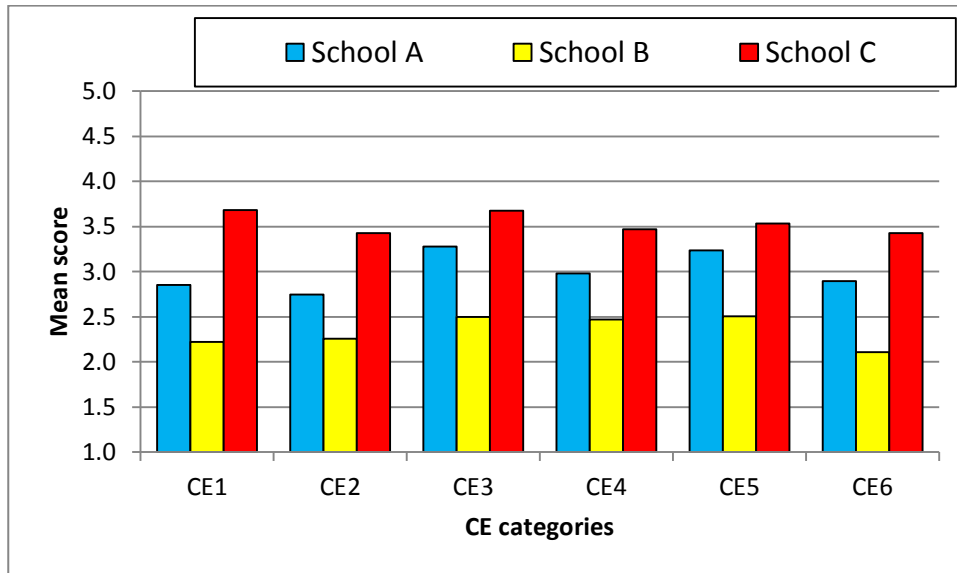
Table 4.12: Descriptive statistics: CE1 to CE6 - School [C]

	CE1	CE2	CE3	CE4	CE5	CE6
N	32	32	32	32	32	32
Mean	3.68	3.43	3.68	3.47	3.53	3.43
S.D.	0.73	0.70	0.72	0.81	0.81	0.83
Minimum	2.40	2.00	2.00	2.00	1.33	1.40
Quartile 1	3.15	3.10	3.15	3.00	3.25	3.00
Median	3.60	3.50	3.70	3.50	3.67	3.60
Quartile 3	4.40	4.00	4.20	4.00	4.00	4.00
Maximum	5.00	4.60	5.00	5.00	5.00	4.80

4.3.5 Comparative mean CE scores by School

The comparative mean scores of the Collective Efficacy (CE) Categories are shown in Figure 4.1. This bar graph shows that School C had the highest mean scores for all the categories, followed by School A which was second highest in all the categories and then lastly School B which had the lowest mean scores in all the categories. This graph also shows that out of the three sample schools, the teachers in School C felt highly self-efficacious about the Collective Efficacy Categories under discussion, followed by School A, whose teachers also felt self-efficacious with mean scores for all the categories greater than 2,60. The teachers of School B felt very low in their self-beliefs about the Collective Efficacy Categories of their school, with mean scores in the majority of the categories less than 2,60. The scores show that the teachers of School C and School A are more *positive* than those of School B, whose teachers are more *negative* about the Collective Efficacy Categories (CE1- CE6).

Figure 4.1: Mean CE categories scores by school

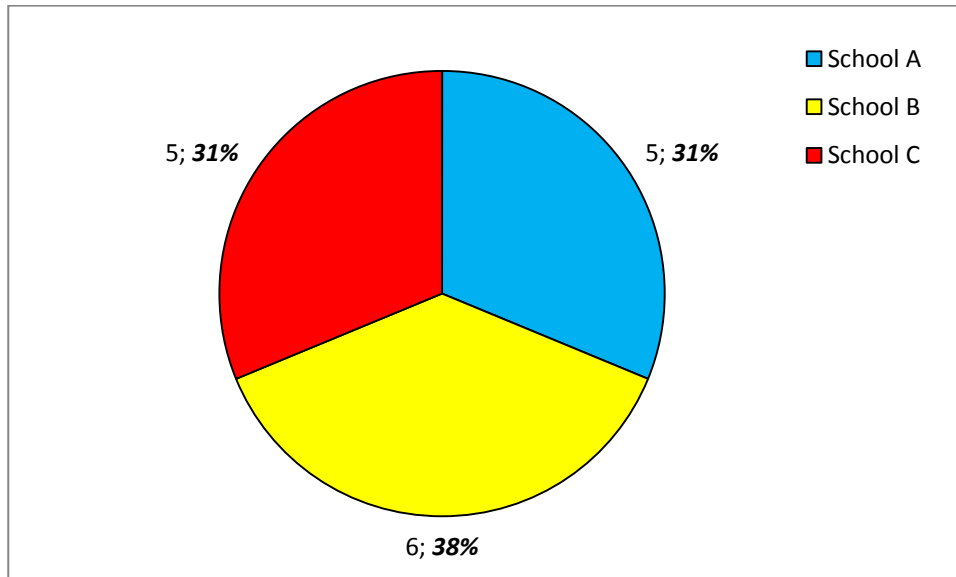


4.4 DESCRIPTIVE STATISTICS OF TEACHER-SELF EFFICACY (TSE)

4.4.1 TSE of all the mathematics teachers (n = 16)

The descriptive statistics of all the mathematics teachers of the sample schools (n = 16) is presented in Figure 4.2. The pie chart below indicates the distribution of the mathematics teachers per sample school namely School A (n = 6) or 31% of the sample, School B (n = 6) or 38% of the sample and School C (n = 5) or 31% of the sample who were surveyed in terms of how their self-efficacy (TSE) beliefs influence their learners in terms of teaching, learning and assessment strategies (refer to Appendix B).

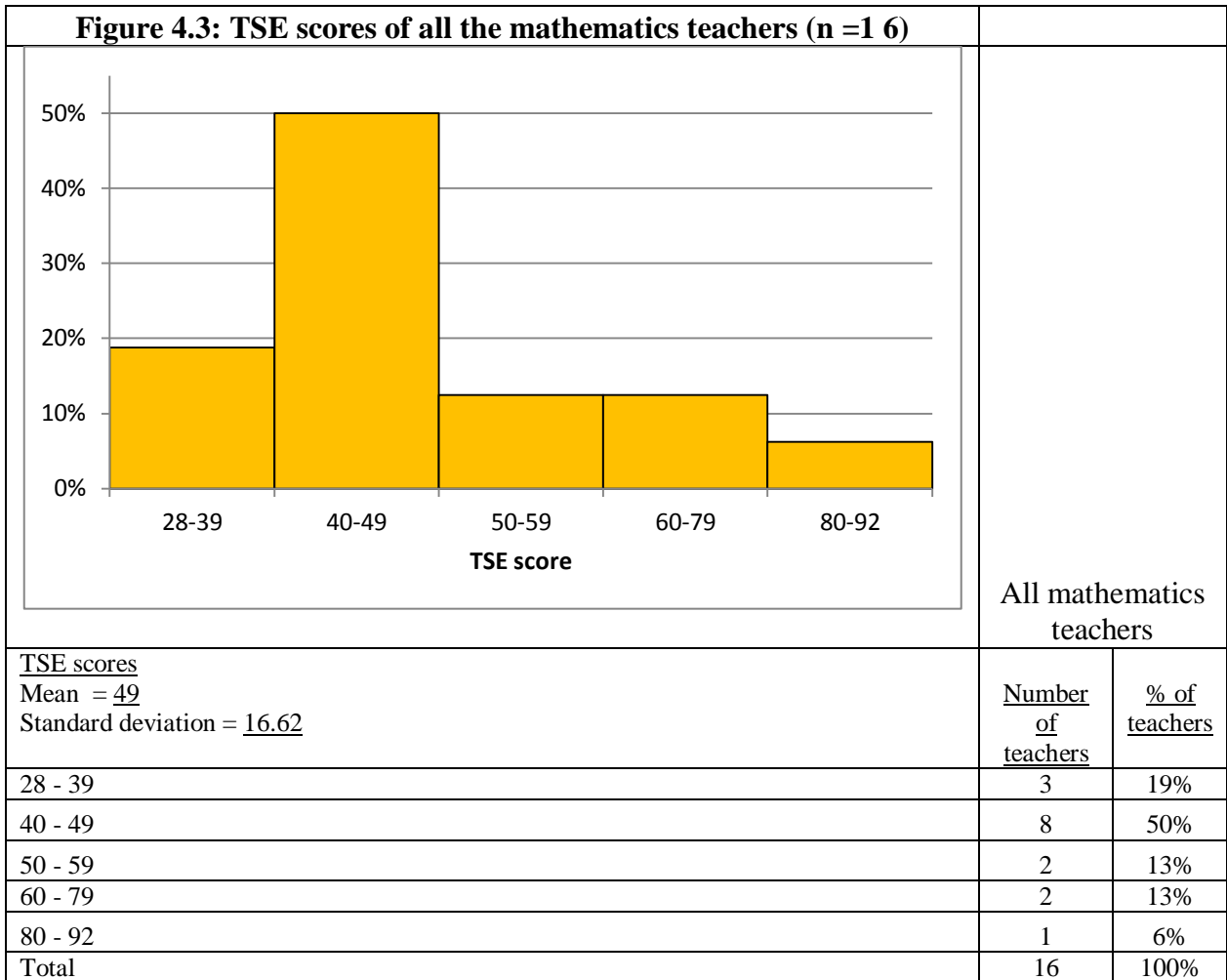
Figure 4.2: Distribution pie chart of all the mathematics teachers (n = 16)



These responses by the teachers are an indication on how the mathematics teachers in the sample schools scored the twenty five statements to probe their control in the classroom with regard to teaching, learning and assessment strategies. The table in Figure 4.3 shows a mean score of 49.0 and a standard deviation of 16.62, which indicates the views of the grade eleven mathematics teachers of the sample schools (n = 6) on the influence of the mathematics teacher as opposed to external factors which are more or less evenly split in terms of their respective influences in the learning environments.

The histogram (Figure 4.3) also shows the levels of teacher self efficacy in (TSE) in the following percentage ranges: very low self-efficacious (28 – 39), low self-efficacious (40 – 49), moderate self-efficacious (50 – 59), high self-efficacious (60 – 79) and very high self-efficacious (80 – 92). The graph below shows that 3 teachers (19%)

show very low self-efficacy, 8 teachers (50%) show low self-efficacy, 2 teachers (13%) show moderate self-efficacy, 2 teachers (13%) show high self-efficacy and 1 teacher (6%) shows very high self-efficacy. The total number of mathematics teachers of the sample schools who show low self-efficacy scores (less than 50%) is $\frac{11}{16}$ or 68,75%, while the mathematics teachers that show high self-efficacy scores (greater than 50%) is $\frac{5}{16}$ or 31,25%. The mathematics teachers of the sample schools show mainly low teacher self-efficacy (TSE) in terms of how they perceive what the role of the mathematics teacher is in controlling the learning environment.



The areas where the control of the curriculum delivery processes is within the influence of the teacher have been highlighted in Table 4.13, as opposed to where the control of the teaching, learning and assessment strategies are beyond the control of the teacher. From the table that follows it is clear that out of the twenty five statements the mathematics teachers scored equal or greater than 50% in $\frac{13}{25}$ statements, which suggests that both the internal factors and the external factors that influence curriculum delivery in the classroom are marginal. The responses of the mathematics teachers were analyzed by the Unit for Statistical Consultation at the Nelson Mandela Metropolitan University; the

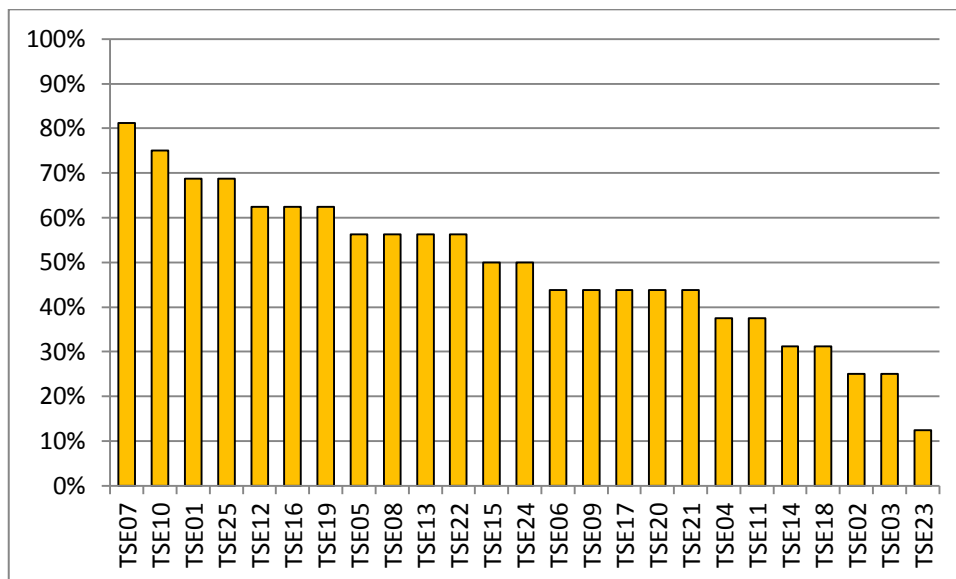
actual statements appear in Appendix B and the spreadsheets in Appendix B2. According to the table below Statement 7 (TSE 07) reflects high self-efficacy perceptions by all the teachers in the sample schools about their control in the classroom with a score of 81%, as opposed to Statement 23 (TSE 23) which reflects low self-efficacy beliefs by the teachers about their control with a score of 13%.

Table 4.13: Descriptive statistics: TSE01 to TSE25 (n = 16)

	Number of correct statement	Statement numbers				% of respondents who selected the correct statement
		1		2		
TSE01	1	11	69%	5	31%	69%
TSE02	2	12	75%	4	25%	25%
TSE03	1	4	25%	12	75%	25%
TSE04	2	10	63%	6	38%	38%
TSE05	1	9	56%	7	44%	56%
TSE06	2	9	56%	7	44%	44%
TSE07	1	13	81%	3	19%	81%
TSE08	1	9	56%	7	44%	56%
TSE09	2	9	56%	7	44%	44%
TSE10	2	4	25%	12	75%	75%
TSE11	2	10	63%	6	38%	38%
TSE12	1	10	63%	6	38%	63%
TSE13	1	9	56%	7	44%	56%
TSE14	2	11	69%	5	31%	31%
TSE15	2	8	50%	8	50%	50%
TSE16	2	6	38%	10	63%	63%
TSE17	1	7	44%	9	56%	44%
TSE18	2	11	69%	5	31%	31%
TSE19	2	6	38%	10	63%	63%
TSE20	1	7	44%	9	56%	44%
TSE21	2	9	56%	7	44%	44%
TSE22	1	9	56%	7	44%	56%
TSE23	2	14	88%	2	13%	13%
TSE24	2	8	50%	8	50%	50%
TSE25	1	11	69%	5	31%	69%

The bar graph (Figure 4.4) indicates the average scores of all the grade eleven mathematics teachers (n = 16) in terms of their teacher self-efficacy (TSE) beliefs. The graph illustrates the areas of curriculum delivery in the sequence where mathematics teachers felt highly efficacious in terms of their self-efficacy beliefs, starting with (TSE 07) with 81% to the areas of curriculum delivery where they felt less efficacious, ending with (TSE 23) with 13%.

Figure 4.4: Responses of all the mathematics teachers (n = 16) in terms of TSE beliefs



4.4.2 TSE of mathematics teachers in School A (n = 5)

Table 4.14 presents the information from the Teacher Self-Efficacy (TSE) questionnaire (refer to Appendix B) of twenty five statements regarding whether the

control of effective teaching, learning and assessment strategies is mainly influenced by the teacher (internal) or whether these curriculum processes are mainly influenced by factors beyond the classroom (external). The score allocation for the table, as previously mentioned is internal control = 1 and external control = 0. The areas where the control of the curriculum delivery processes are perceived to be within the influence of the teacher (internal control), have been highlighted. The mathematics teachers from School A have scored $\frac{12}{25}$ or 48% of the statements to be influenced by the teacher, which suggests they believe that the influence of internal factors on the influence on curriculum delivery is marginally less than that of the external factors. The score that reflected the highest efficacy occurs for Statement 7 (TSE07) with 100% where all five teachers felt that they were in control of the curriculum delivery process, as opposed to the statement where the teachers felt very low in their self-efficacy beliefs, namely Statement 2 (TSE 02) with 0%, where all five teachers felt that the curriculum delivery process is not influenced by them, but by factors beyond the classroom situation. The mathematics teachers of School A were overall *more self-efficacious* in their responses as most of the scores above 50% were in the ratio of $\frac{3}{5}$ in favour of the highly efficacious teachers.

Table 4.14: Descriptive statistics: TSE01 to TSE25 - School [A] (n = 5)

	Number of correct statement	Statement numbers				% of respondents who selected the correct statement
		1		2		
TSE01	1	3	60%	2	40%	60%
TSE02	2	5	100%	0	0%	0%
TSE03	1	2	40%	3	60%	40%
TSE04	2	4	80%	1	20%	20%
TSE05	1	2	40%	3	60%	40%
TSE06	2	3	60%	2	40%	40%

TSE07	1	3	60%	2	40%	60%
TSE08	1	3	60%	2	40%	60%
TSE09	2	3	60%	2	40%	40%
TSE10	2	2	40%	3	60%	60%
TSE11	2	3	60%	2	40%	40%
TSE12	1	2	40%	3	60%	40%
TSE13	1	3	60%	2	40%	60%
TSE14	2	2	40%	3	60%	60%
TSE15	2	2	40%	3	60%	60%
TSE16	2	3	60%	2	40%	40%
TSE17	1	3	60%	2	40%	60%
TSE18	2	2	40%	3	60%	60%
TSE19	2	4	80%	1	20%	20%
TSE20	1	2	40%	3	60%	40%
TSE21	2	2	40%	3	60%	60%
TSE22	1	3	60%	2	40%	60%
TSE23	2	4	80%	1	20%	20%
TSE24	2	3	60%	2	40%	40%
TSE25	1	5	100%	0	0%	100%

4.4.3 TSE of mathematics teachers in School B (n = 6)

Table 4.15 presents the information of School B from the Teacher Self-Efficacy (TSE) questionnaire (refer to Appendix B) of twenty five statements regarding whether the control of effective teaching, learning and assessment strategies is influenced mainly by the teacher (internal) or whether these curriculum processes are influenced mainly by factors beyond the classroom (external). The areas where the control of the curriculum delivery processes is believed to be within the influence of the teacher (internal control) have been highlighted. The mathematics teachers from School B have scored $\frac{7}{25}$ statements to be influenced by the teacher, which suggests that they believe that the internal factors that influence curriculum delivery are overshadowed by factors that are

not within the control of the mathematics teacher. The scores that reflected the highest efficacy are those of Statement 25 (TSE25) and Statement 19 (TSE 19) with 100%, where all five teachers felt that they were in control of the curriculum delivery process, as opposed to the statement where the teachers felt very low in their self-efficacy beliefs, namely Statement 2 (TSE 02) with 0% where all five teachers felt that the curriculum delivery process is not influenced by them, but by factors beyond the classroom situation. The mathematics teachers of School B were overall *less self-efficacious* in their responses as $\frac{18}{25}$ or 72% of the responses were less than 50% in all of the twenty five statements.

Table 4.15: Descriptive statistics: TSE01 to TSE25 - School [B] (n = 6)

	Number of correct statement	Statement number				% of respondents who selected the correct statement
		1		2		
TSE01	1	4	67%	2	33%	67%
TSE02	2	4	67%	2	33%	33%
TSE03	1	0	0%	6	100%	0%
TSE04	2	3	50%	3	50%	50%
TSE05	1	4	67%	2	33%	67%
TSE06	2	4	67%	2	33%	33%
TSE07	1	6	100%	0	0%	100%
TSE08	1	3	50%	3	50%	50%
TSE09	2	5	83%	1	17%	17%
TSE10	2	2	33%	4	67%	67%
TSE11	2	4	67%	2	33%	33%
TSE12	1	5	83%	1	17%	83%
TSE13	1	2	33%	4	67%	33%
TSE14	2	5	83%	1	17%	17%
TSE15	2	4	67%	2	33%	33%
TSE16	2	3	50%	3	50%	50%
TSE17	1	2	33%	4	67%	33%
TSE18	2	6	100%	0	0%	0%
TSE19	2	0	0%	6	100%	100%
TSE20	1	2	33%	4	67%	33%

TSE21	2	4	67%	2	33%	33%
TSE22	1	4	67%	2	33%	67%
TSE23	2	6	100%	0	0%	0%
TSE24	2	3	50%	3	50%	50%
TSE25	1	3	50%	3	50%	50%

4.4.4 TSE of mathematics teachers in School C (n = 5)

Table 4.16 presents the information from the Teacher Self-Efficacy (TSE) questionnaire (refer to Appendix B) of twenty five statements regarding whether the control of effective teaching, learning and assessment strategies is influenced mainly by the teacher (internal) or whether these curriculum processes are influenced mainly by factors beyond the classroom (external). The areas where the control of the curriculum delivery processes is mainly within the influence of the teacher (internal control) have been highlighted. The mathematics teachers from School C have scored $\frac{15}{25}$ or 60% of the statements to be influenced mainly by the teacher, which suggests that the internal control factors overshadowed the external factors regarding the main influence on curriculum delivery in the mathematics classroom. The scores that reflected high efficacy are for statements that were scored highly, which were Statement 10 (TSE 10) and Statement 16 (TSE 16) with 100%, where all five teachers felt that they were in control of the curriculum delivery process, as opposed to the statements where the teachers felt very low in their self-efficacy beliefs, namely Statement 14 (TSE 14) and Statement 23 (TSE 23) with 20%, where all five teachers felt that the curriculum delivery process is not influenced mainly by them, but by factors beyond the classroom situation. The mathematics teachers of School C were overall *highly self-efficacious* in their responses

as most of the scores above 50% were in the ratio of $\frac{3}{5}$ and above in all of the twenty five statements.

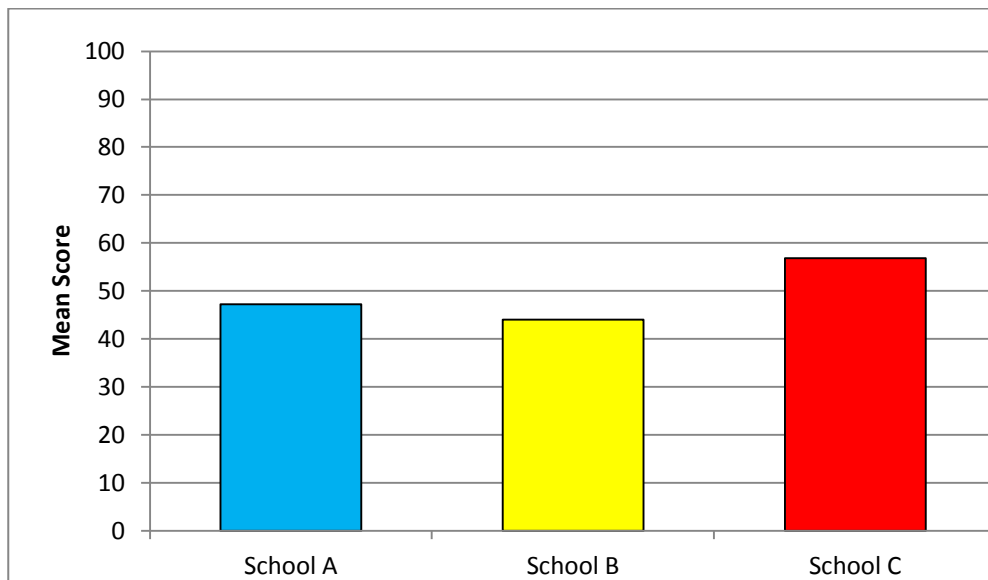
Table 4.16: Descriptive statistics: TSE01 to TSE25 - School [C] (n = 5)

	Number of correct statement	Statement numbers				% of respondents who selected the correct statement
		1		2		
TSE01	1	4	80%	1	20%	80%
TSE02	2	3	60%	2	40%	40%
TSE03	1	2	40%	3	60%	40%
TSE04	2	3	60%	2	40%	40%
TSE05	1	3	60%	2	40%	60%
TSE06	2	2	40%	3	60%	60%
TSE07	1	4	80%	1	20%	80%
TSE08	1	3	60%	2	40%	60%
TSE09	2	1	20%	4	80%	80%
TSE10	2	0	0%	5	100%	100%
TSE11	2	3	60%	2	40%	40%
TSE12	1	3	60%	2	40%	60%
TSE13	1	4	80%	1	20%	80%
TSE14	2	4	80%	1	20%	20%
TSE15	2	2	40%	3	60%	60%
TSE16	2	0	0%	5	100%	100%
TSE17	1	2	40%	3	60%	40%
TSE18	2	3	60%	2	40%	40%
TSE19	2	2	40%	3	60%	60%
TSE20	1	3	60%	2	40%	60%
TSE21	2	3	60%	2	40%	40%
TSE22	1	2	40%	3	60%	40%
TSE23	2	4	80%	1	20%	20%
TSE24	2	2	40%	3	60%	60%
TSE25	1	3	60%	2	40%	60%

4.4.5 Comparative mean TSE scores by school

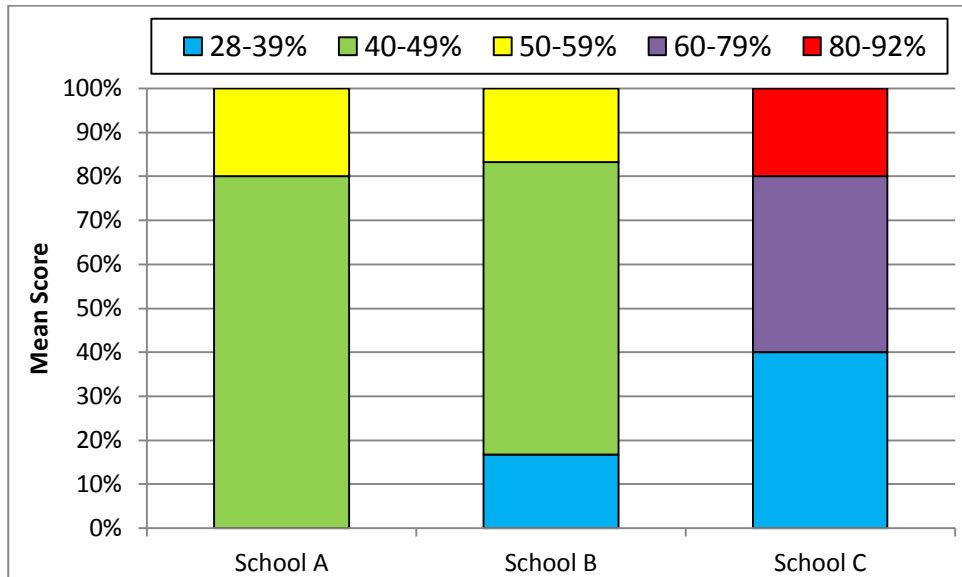
Figure 4.5 shows the Comparative Mean Teacher Self-Efficacy (TSE) scores of the three sample schools. The graph shows clearly that the mathematics teachers of School C have the highest TSE mean score of 56,8% followed by School A with a mean score of 47,2 % and lastly by School B with a mean score of 44,0%. The mathematics teachers of School C are therefore highly self-efficacious about the influence they exert over and above the external factors that might influence teaching, learning and assessment strategies, followed by School A whose mathematics teachers are also self-efficacious about their influence and lastly by School B whose teachers are less self-efficacious about their influence over their learners as opposed to external factors that might influence the ability of their learners.

Figure 4.5: Mean TSE scores by school



The bar graph (Figure 4.6) shows the responses of the mathematics teachers per sample school in terms of their Teacher Self –Efficacy (TSE) beliefs about their influence over their learners in the mathematics classroom. The graph shows that at School C (n = 5) the mean scores are most favourable where 2 teachers (40%) TSE scores are between 28 - 39%, 2 teachers (40%) are between 60 - 79% and 1 teacher (20%) is between 80 - 92%. School B (n = 6) shows less favourable TSE mean scores where 1 teacher (16,7%) is between 28 - 39%, 4 teachers (66,6%) are between 40 - 49% and 1 teacher (16,7%) is between 50 - 59%. The mathematics teachers of School A (n = 5) are more self-efficacious than School B with 4 teachers (80%) between 40 - 49% and 1 teacher (20%) between 50-59%. The data show that the mathematics teachers of School C are highly self-efficacious, followed by the mathematics teachers of School A who also show positive Teacher Self-Efficacy (TSE) beliefs and lastly by School B whose mathematics teachers show mostly negative TSE beliefs in exerting influence over their learners in the classroom as opposed to external factors outside the control of the teacher.

Figure 4.6: Mean TSE scores by mathematics teachers per school



4.5 ANALYSIS OF SEMI –STRUCTURED INTERVIEWS

The interview data are presented and analyzed in the three coherent categories that revealed themselves during the inspection and analysis process used in this study. The analysis of the interview data is presented according to the following three themes namely Theme 1: *Teachers’ understanding of the concept of outcomes-based education*, Theme 2: *Teachers’ understanding of a new curriculum statement in mathematics*, Theme 3: *Teachers’ expositions of mathematics in the schools where they teach*. The analysis is presented according to the above-mentioned themes, with the sample schools as sub-headings, and the quotations from the semi-structured interviews are inserted as incursive.

The interviews of the mathematics teachers (n = 6) have been transcribed in text according to the themes as outlined in the transcriptions (refer to Appendix C3). The teachers of School A (n = 2) are referred to as Teacher A₁ and Teacher A₂, School B (n = 2) as Teacher B₁ and Teacher B₂ and School C (n = 2) as Teacher C₁ and Teacher C₂.

The analysis of the semi-structured interviews is guided by the findings in the themes and questions as set out in the Table 4.17.

Table 4.17: Themes and questions of the semi-structured interviews

THEMES	QUESTIONS
<ul style="list-style-type: none"> ● Theme 1: Teachers understanding of the concept of outcomes-based education OBE. 	<ul style="list-style-type: none"> ● What does outcomes-based education mean to you as a mathematics educator? ● In your experience with outcomes-based education, what are the challenges in having an outcomes-based approach to (a) teaching strategies (b) learning strategies (c) assessment strategies? How do you respond to these challenges as a mathematics teacher?

<ul style="list-style-type: none"> ● Theme 2: Teachers' understanding of a new curriculum statement in mathematics. 	<ul style="list-style-type: none"> ● In your opinion where do you think are the most significant changes of the new curriculum for mathematics in grade 11? Do these changes add value to a better understanding of mathematics? ● Is the new curriculum in grade 11 easier or more challenging to complete than the old NATED 550 curriculum? In which areas of the new mathematics curriculum do you think the degree of difficulty has improved or declined? ● Which of the disciplines of mathematics (Algebra, Trigonometry, Analytical Geometry, Transformation Geometry, Data Handling and Surface Area and Volume) do your learners understand better and which are the areas they battle with? Did these changes impact positively or negatively on the pass rate of your grade 11 learners in the final external examination last year?
<ul style="list-style-type: none"> ● Theme 3: Teachers' expositions of mathematics in the schools where they teach. 	<ul style="list-style-type: none"> ● In your opinion, is there a willingness from the mathematics teachers in your school to teach with commitment, irrespective of the impact of negative external factors (e.g. lack of textbooks and other resources, overcrowding etc.)? ● Did all the mathematics teachers in your school receive in-service training from subject advisors from the Department of Education regarding the content of the new curriculum? Was the training effective and relevant to the topics in the curriculum? Are there alternatives to strengthen teaching efficiency in your school? ● Outcomes-based education (OBE) requires from teachers to have a learner-centred approach to teaching, learning and assessment as opposed to a teacher-directed approach. In your experience, does an outcomes-based approach in teaching contribute to a better understanding of mathematics or not?

	<ul style="list-style-type: none"> ● If learners in one of the classes underperform in mathematics, who in your opinion should be held accountable for the poor results, an ineffective teacher OR learners with negative learning attitudes OR both? ● What, in your opinion, could be done by the management of your school if the results for mathematics are much higher than anticipated? Should appraisals/incentives for both teachers and learners be introduced to show appreciation? ● What support structures exist in or outside your school to support learners who are struggling with mathematics? ● If you were teaching at a more affluent school, would you get better results in mathematics as opposed to where you teach now OR do good results only depend on the quality of the mathematics teacher and the dedication of the learners irrespective in what school you teach?
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4.5.1 Theme 1: Teachers' understanding of the concept of outcomes-based education (OBE)

The NCS, as was with C2005 , according to Sebela, (2009:2) has an outcomes-based approach to education, which requires teaching methods that are learner-centred, an approach that requires learners to participate in classroom activities, become more involved in the learning process and take responsibility for their own learning. The understanding of the concept of outcomes-based education by mathematics teachers is important regarding the manner in which they teach, how their learners learn and how their learners' work is assessed.

The implementation of outcomes-based education and specifically the new curriculum statement has been problematic, due to a number of systemic problems. The problem with an outcomes-based approach in the New Curriculum Statement is ironically the fact that, according to a report by a panel of experts which was appointed in July 2009 to investigate challenges and problems in the New Curriculum Statement, it does not deliver the desired outcomes in terms of learner performance (Motshekga, 2009:1). The changes to the approach to teaching, learning and assessment in the New Curriculum Statement, will take effect from January 2010 (Motshekga, 2009:1). Teachers will be provided with systematic support to strengthen their teaching techniques, and relieved of administrative burdens that impact on teaching time. A relief of these administrative duties includes a discontinuation of the formal compilation of assessment requirements, because some of these assessment requirements did not add any value, instead they distract both teachers and learners from the core function of the curriculum.

- **School A (n = 2)**

On the question of what outcomes-based education means to the mathematics teachers, one of the mathematics teachers could not differentiate between outcomes-based education and the traditional approach to teaching.

“Not much. The teaching of mathematics has always been interactive and attempts are always made to accommodate learners at different levels.” (Teacher A₁)

The other mathematics teacher gave an explanation of outcomes-based education as a method of teaching in the context of how mathematics should be taught.

“It is a method of teaching that focuses on what learners actually do after they are taught. The desired outcome is selected first and the curriculum is created to support the intended outcome.” (Teacher A₂)

Both the mathematics teachers expressed their frustration about the implementation of outcomes-based education in terms of teaching, learning and assessment strategies. The issues of time management, work overload and resource constraints are major concerns for these teachers.

“...too much teaching time gets wasted on administrative work, many learners don’t have access to resource materials and there is too much paper work and administration.” (Teacher A₁)

“... to set the desired outcomes before the lesson and actually achieving those outcomes, some learners are not motivated to learn by themselves and some learners struggle in tests and do not hand in their projects and assignments in time.” (Teacher A₂)

- **School B (n = 2)**

Both the mathematics teachers showed good understanding of the methodology that outcomes-based education proclaims to be.

“You should teach in such a manner that your learners gradually grasp the concept themselves by seeing the link between existing and newly acquired knowledge.”

(Teacher B₁)

“Outcomes-based education is learner-centred teaching, for an example group work.”

(Teacher B₂)

Both mathematics teachers are explaining the problem with regard to the implementation process of outcomes-based education, but also simultaneously giving advice on what could be done to ensure effective implementation. The concerns raised by these two teachers are that the assessment guidelines are not too clear and that some of the assessment tasks given to learners are too time consuming. They also agree that active learner participation should be central to the teaching process for outcomes-based education to be effective.

“...you cannot leave it entirely up to the learners to achieve the outcome, learners should take part actively and involve themselves, if they don't they run the risk of not achieving the outcome and clearer guidelines should be given on how and which assessment strategies should be used.” **(Teacher B₁)**

“...teaching must be learner-centred; it must involve learners more in the activities. Learners can work as individuals or in groups in activities such as projects and investigations and tests and investigations and projects are time-consuming and make it difficult to keep up with the pace setter.” **(Teacher B₂)**

- **School C (n = 2)**

Both the mathematics teachers explained the methodology behind outcomes-based education correctly. The responses by the mathematics teachers are the same in the sense that they agree that outcomes-based education should be learner-centred and that all curriculum processes should be centred on the learners.

“OBE is learner-centred, so all the teaching efforts must be to the benefit of the learner.” (Teacher C₁)

“It is a learner-centred approach which seeks to develop a child in totality.”

(Teacher C₂)

Both the mathematics teachers expressed their frustration not only about resource constraints e.g. overcrowding and a lack of learning materials, but also on attitudes of learners in terms of their schoolwork as the main obstacles to be overcome to ensure effective teaching, learning and assessment practices in their school.

“...over-crowded classrooms make it difficult to pay individual attention to learners, a lack of textbooks makes it difficult for learners to learn and negative attitudes towards assessment tasks are major challenges.”(Teacher C₁)

“...over-crowded classrooms complicate teaching, the school lacks proper learning materials like textbooks and the learners are not motivated to prepare themselves for tests and examinations.”(Teacher C₂)

4.5.2 Theme 2: Teachers' understanding of a new curriculum statement in mathematics

Mathematics in the NCS curriculum is defined in terms of four learning outcomes (LO's) namely LO 1: *Number and Number Relationships*; LO 2: *Functions and Algebra*; LO 3: *Space, Shape and Measurement* and LO 4: *Data Handling and Probability*. The intention for each learning outcome, according to Parker (2006:63) is elaborated through assessment standards (AS's) and is supported by further content and context statements. The understanding of the new curriculum statement in mathematics is an important consideration when mathematics teachers deal with the new curriculum, not only for comparative reasons with the old NATED 550 curriculum, but also for the challenges it poses in terms of the new content and the taxonomy levels of the various disciplines for both teachers and learners.

- **School A (n = 2)**

One teacher mentioned correctly the removal of only one discipline namely Euclidean Geometry from the new curriculum as one of the major changes from the old NATED 550 curriculum, while the other teacher mentioned a few topics that were added to the new curriculum such as Linear Programming, Transformation Geometry and Data Handling.

The one teacher felt that mathematics has become easier in certain areas and more difficult in others...*"The mathematics has become easier in certain areas like*

Transformation Geometry and Data Handling, but learners still battles with trigonometry.” (Teacher A₁). The other teacher also felt the same... *“I think learners understand Algebra better. Transformation Geometry is the most difficult part.” (Teacher A₂)*

Both teachers mentioned that the changes that outcomes-based education brought along did not impact too much on how learners understand mathematics. On the question of whether outcomes-based education contributes to a better conceptual understanding, the response of the one teacher was not as forthcoming... *“No. Teaching of mathematics has not changed much with the introduction of OBE.” (Teacher A₁).* The other teacher also felt the same... *“No, certain learners still battle to understand and apply certain concepts when they have to solve problems.” (Teacher A₂)*

With regard to the responses to the question of whether the changes in the NCS curriculum impact the pass rate of the grade eleven learners positively or negatively, the one teacher had mixed views on the issue... *“A little of both. The mathematics has become easier in certain aspects, but the amount of work makes it difficult to complete the syllabus.” (Teacher A₁).* The other teacher felt that the changes made no impact... *“Not really, because the learners still struggle to understand mathematics. It was the same with the old syllabus.” (Teacher A₂)*

- **School B (n = 2)**

The response by the one mathematics teacher on the significant changes is related to the new topics that were introduced... *“Space, Shape and Measurement as well as Data Handling.”* (**Teacher B₁**). The other teacher mentioned the topics that were introduced and the new topics that were left out... *“Statistics are new and Euclidean Geometry has been omitted.”* (**Teacher B₂**)

On the question of whether the changes had any impact on the level of understanding of the mathematics learners, the first teacher was cautiously optimistic... *“Yes, definitely. Geometry was more abstract and learners struggled most with the theorems, while Data Handling can be seen as bonus points, if learners have a clear understanding.”* (**Teacher B₁**). The second teacher was neutral on the issue... *“Yes and No. Yes, because statistics are applied in real life situations. No, because Euclidean Geometry has an effect on thinking ability.”* (**Teacher B₂**)

Both teachers agreed that the work in the NCS curriculum is more cognitively challenging than the work in the old NATED 550 curriculum, citing Trigonometry and Functions as the difficult areas... *“It is more challenging. The Euclidean Geometry was omitted, yet quite a few new concepts were added to the curriculum, which learners are still struggling with.”* (**Teacher B₁**). The other teacher also confirmed the same sentiment... *“It is more challenging, because the learners don’t understand the work.”* (**Teacher B₂**)

On the issue of the impact of the curriculum changes on the pass rate of the learners in the external examination, the responses of both the teachers were pessimistic... *“It influences them negatively. There is too much work to handle and little time. By the time the learners have to write the external examination, certain topics have not been covered extensively.”* (Teacher B₁). The other teacher responded as follows... *“Negatively, because the learners just don’t perform and that impact on their attitudes towards mathematics.”* (Teacher B₂)

- **School C (n = 2)**

Both teachers showed relatively good understanding of the major changes that were introduced in the new curriculum. Their responses to what the significant changes of the new curriculum were... *“Financial Mathematics, Data Handling and Transformation Geometry came in, while Euclidean Geometry is out.”* (Teacher C₁). The other teacher responded... *“Euclidean Geometry has been taken out and Data Handling and Transformation Geometry have been introduced.”* (Teacher C₂)

On the question of whether the changes in the NCS curriculum develop better understanding of mathematics, the teachers were careful in their optimism... *“Yes, Paper 2 is easier than Paper 2 in NATED 550, but the learners still struggle.”* (Teacher C₁). The response of the other teacher was similar... *“Yes. The learners are enjoying Paper 2 more than Paper 1.”* (Teacher C₂)

Both participants are in agreement that the new curriculum is more challenging than the old NATED 550 curriculum, and that the degree of difficulty of the work has improved.... *“It is more challenging to complete, because Financial Maths and Functions are challenging for them”*... *“Data Handling is easier for them, but they struggle with the other topics.”* (**Teacher C₁**). The other teacher responded... *“Yes, it is more challenging to complete. There is a lot of work to complete and learners understand the work very slowly”*... *“Definitely improved, especially in Financial Maths and Functions.”* (**Teacher C₂**)

The teachers also agree that the changes in the NCS curriculum had a negative impact on the pass rate of their learners in the external examination for grade eleven.... *“Negatively, because they struggle with new and changed topics.”* (**Teacher C₁**). The response from the other mathematics teacher... *“Negatively, because they get less marks for Paper 1.”* (**Teacher C₂**)

4.5.3 Theme 3: Teachers’ expositions of mathematics in the schools where they teach

The teachers’ expositions of mathematics is an important part of this research, because those perceptions determine the effectiveness of the teaching, learning and assessment strategies of these teachers in the mathematics classrooms of the schools where they teach. Research by Swars (2005:139) found that teacher efficacy is a significant predictor of mathematics instructional strategies, and highly efficacious

teachers are more effective mathematics teachers than teachers with a lower sense of efficacy.

This adverse socio-economic status of these schools is an important consideration for this study, as all three the sample schools are situated in previously disadvantaged communities. Research that was done by Goddard *et al.* (2000), according to Brinson and Steiner (2005:2), found that even taking into consideration the effect of the learners' demographics such as race, socio-economic status and gender (factors beyond the control of the school), perceptions of collective efficacy were stronger predictors of academic achievement.

- **School A (n = 2)**

Both teachers agreed that the commitment of their teachers was never in doubt even under challenging socio-economic conditions... *"Yes. We have a dedicated group of mathematics teachers."* (**Teacher A₁**). The other teacher responded the same... *"Yes, because the teachers care for the welfare of the learners."* (**Teacher A₂**)

The teachers were divided on the question of who should be held responsible for poor results of the mathematics learners ... *"It is difficult to say. At the end of the day, I suppose the teacher is always accountable"* (**Teacher A₁**). The response of the other teacher was different... *"I think learners with negative learning attitudes are responsible for poor results."*

(Teacher A₂)

Both teachers agreed that the management of their school could do better to motivate both teachers and learners if results improve by introducing an appraisal or incentive system.

“To acknowledge both the efforts of both the teacher and the learners. Incentives for the learners should be in place so as to encourage learners to always to their best.”

(Teacher A₁)

*“Incentives for the learners should be in place so as to encourage learners to always do their best. Yes, especially to learners who get very good marks in the examinations.”***(Teacher A₂)**

The teachers were divided on the issue of whether effective support structures exist to assist learners who are struggling with mathematics... *“None that I know of.”* **(Teacher A₁)**. The other teacher responded differently... *“Extra lessons. Extra lessons are effective for slow learners, because more time can be spend to explain difficult concepts.”* **(Teacher A₂)**

Both teachers agreed that the socio-economic conditions of a school influence academic results.

“The socio-economic background of our learners has a huge impact on their results. Many of our learners have added responsibilities at home (chores like looking after siblings) and do not have much time to dedicate to their studies. We therefore have two or more learners who do well, while more affluent schools have a greater percentage of their learners excelling.” (Teacher A₁)

“Results will depend on the teacher and the background of the learners. Most of the learners who are learning here are having social problems. Model C learners perform better than our learners, because they go for private tuition. It also depends on the attitude and the interest of the learner.” (Teacher A₂)

- **School B (n = 2)**

Both teachers agreed that the teachers are committed, even under difficult circumstances, but questioned the commitment of their learners.

“Yes. Even as a maths teacher I do not have adequate resources to assist with the teaching of the subject, I find it alarming that the number mathematics learners drop annually. I fear the subject might die a slow death or become extinct at my school.” (Teacher B₁)

“Yes. Teachers are all committed, but not all the learners.” (Teacher B₂)

On the question of who should be held accountable for poor results of learners, both teachers agreed that teachers and learners should be held accountable, but was not clear to what extent each one is accountable... *“Both. As a teacher one must find alternative methods to improve learners’ attitudes towards the subject. Not all the learners that struggle should be seen as lost causes. Learners should also be self-motivated to do better and achieve more.”* (**Teacher B₁**). The other teacher responded... *“Both, because teachers fail to motivate learners.”* (**Teacher B₂**)

There is also agreement between the two teachers that the efforts of both teachers and learners should be acknowledged if the results improved... *“The efforts of both teachers and learners must be acknowledged. For teachers, a thank you-note or special mention in the assembly will mean a lot. Also award certificates should be given to learners in a special assembly and a special mention should be made of their achievements. They should be encouraged to do better. Yes, I think so. As human beings we all thrive on being acknowledged for our efforts, and if others recognize that we are motivated, we will do even better.”* (**Teacher B₁**). The response of the other teacher was... *“Hard work from teachers and learners should be appreciated. Yes, both teachers and learners should be encouraged.”* (**Teacher B₂**)

Both the teachers acknowledge that support structures are in place to support struggling mathematics learners, but question the effectiveness of these structures... *“Most of the teachers offer extra classes as an improvement plan to assist learners. Only those learners that are serious will take note what is serious to them. It does help certain*

learners that are serious about their futures. Some learners do not see the need for these classes and don't attend.” (**Teacher B₁**). The other teacher shared the same sentiment...
“Special classes from teachers. These classes will only be effective if the attitude of the learners towards their school work improves.” (**Teacher B₂**).

Both teachers felt that their results would be better in an affluent school, as certain obstacles in their current school hinder them from obtaining good results... *“Results will be better in a more affluent school, because those schools have more support structures like extra classes. The parents and the learners are motivated to do better and achieve more. Their learning environment is also more pleasing to assist with effective learning.”* (**Teacher B₁**). The other teacher responded... *“Results will be different depending on the learners' attitude, ability and dedication. Social circumstances also affect results. My results will be better at a more affluent school.”* (**Teacher B₂**)

- **School C (n = 2)**

Both teachers agreed that, despite the difficulties they face at their school, they have committed and dedicated teachers.

“Yes. We got hardworking and dedicated teachers.” (**Teacher C₁**)

“Our maths teachers are hard workers.” (**Teacher C₂**)

The teachers also shared the same sentiment that teachers and the learners be held accountable for poor academic results.

“Both. We need both qualified teachers and dedicated learners to get good results.” (Teacher C₁)

“Both, because teachers are here to teach and learners are at school to learn.”
(Teacher C₂)

The teachers also felt that the management of the school should do more to acknowledge the efforts by both teachers and learners if there is an improvement in the results... *“Teachers and learners must be appreciated for their good efforts. Yes, they must be appreciated.” (Teacher C₁)*. The response of the other teacher... *“Teachers and learners should be appreciated for the good work they do. Yes. Any token of appreciation will do, because it will motivate other teachers and learners.” (Teacher C₂)*

Both teachers are aware of support structures in the school that assist learners who are struggling with mathematics, but are concerned about the effectiveness of these structures.

“Extra classes are provided by the Education Department. Not really, because some of the learners may not get a chance to attend extra classes, because these projects choose only the brilliant kids.” (Teacher C₁)

“Extra classes for learners. These classes do not benefit all the learners, because they only choose the bright ones to participate in these programmes.” (Teacher C₂)

The responses of these two teachers on whether they will get better results at a more affluent school were very positive in the sense that they imply that good results only depend on the quality of the teacher and the dedication of the learners, irrespective of the socio-economic status of the school.

“Better results depend on good teachers and dedicated learners.” (Teacher C₁)

“Good results depend on the effort the learners put in their school work. They are the ones that must take responsibility for their own learning, irrespective in what school they are.” (Teacher C₂)

4.5.4 Comparative summary of the semi-structured interviews

The semi-structured interviews are concisely summarized in Table 4.18 below according to the sample schools, themes and the subsequent questions as set out in Table 4.17. The responses of the mathematics teachers who were interviewed are generally described in the table as follows:

Table 4.18: Concise summary of responses by the mathematics teachers (n = 6)

Name of School	Theme 1	Theme 2	Theme 3
School A (n=2)	<i>overall positive</i>	<i>overall positive</i>	<i>overall positive</i>
School B (n=2)	<i>overall negative</i>	<i>overall negative</i>	<i>overall negative</i>
School C (n=2)	<i>overall positive</i>	<i>overall positive</i>	<i>overall positive</i>

The interviews were used firstly, to reconcile certain patterns in the qualitative data of the responses by the mathematics teachers in terms of the themes by the sample schools. Secondly the interviews were used to compare certain patterns across the quantitative data of the responses from all the teachers collected on the collective efficacy questionnaire and the teacher self-efficacy questionnaire (refer to Figure 4.1 and Figure 4.5). In order to cross-refer the effectiveness of both the data on the questionnaires and the responses of the interviews, a mathematics test was written by the grade twelve learners of the sample schools on grade eleven content (refer to Appendix D), the data were summarized on a spreadsheet (refer to Appendix D4) and independently analyzed by the Unit for Statistical Consultation at the Nelson Mandela Metropolitan University.

4.6 DESCRIPTIVE STATISTICS OF THE MATHEMATICS TEST (MATHS)

4.6.1 Mathematics test for all the learners (n = 100)

The mathematics test consisted of four multiple answer options (refer to Appendix D) and was administered to all the grade twelve learners of the sample schools. The test was informed by the learning outcomes and the assessment standards of the grade eleven mathematics curriculum and was written under examination conditions in the respective sample schools. The test was used as a baseline assessment instrument to assess the grade twelve mathematics learners' conceptual understanding on six different disciplines or categories, namely Algebra, Trigonometry, Analytical Geometry, Transformation Geometry, Data Handling and Surface Area and Volume. The test was moderated and quality assured by the Eastern Cape Department of Education (refer to Appendices E and F). The responses of the learners (n = 100) were collected on spreadsheets (refer to Appendix D4) for the respective sample schools, and were independently analyzed by the Unit for Statistical Consultation at the Nelson Metropolitan University.

The three schools for the Mathematics Test were School A (n = 23), School B (n = 26) and School C (n = 51). The data were analyzed by using item analysis and the data in Table 4.19 give the responses to the thirty five statements (Alg. 01 to SAV. 35) scored by all the grade twelve mathematics learners (n = 100) of the sample schools. The correct option for each statement is highlighted and these show that in $\frac{22}{35}$ statements more than 50% of the learners selected the correct option. The easiest statement, according to the

table below is Statement 19 (Trig. 19) with 100% correct responses and the most problematic statement is Statement 29 (TrGeo 29) with 13% correct responses.

Table 4.19: Descriptive statistics: Alg.01 to SAV.35 (n = 100)

	Number of correct option	1	2	3	4	% of respondents who selected the correct options
Alg.01	2	36	58	3	3	58
Alg.02	4	10	21	18	51	51
Alg.03	3	1	10	89	0	89
Alg.04	3	7	23	64	6	64
Alg.05	3	32	7	56	5	56
Alg.06	2	6	88	3	3	88
Alg.07	1	45	40	14	1	45
Alg.08	3	16	26	47	11	47
Alg.09	2	19	52	22	7	52
Alg.10	2	52	23	12	13	23
Alg.11	1	67	19	9	5	67
Alg.12	4	20	8	40	32	32
Alg.13	2	17	57	10	16	57
Alg.14	2	10	76	12	2	76
Alg.15	2	33	26	23	18	26
Trig.16	2	7	72	6	15	72
Trig.17	3	39	25	25	11	25
Trig.18	1	43	22	31	4	43
Trig.19	1	100	0	0	0	100
Trig.20	3	20	19	39	22	39
Trig.21	2	25	30	23	22	30
Trig.22	4	11	18	12	59	59
AnGeo.23	3	13	14	67	6	67
AnGeo.24	1	65	18	12	5	65
AnGeo.25	2	9	62	23	6	62
AnGeo.26	4	7	9	3	81	81
AnGeo.27	3	3	10	86	1	86
TrGeo.28	1	41	19	25	15	41
TrGeo.29	3	29	7	13	51	13
TrGeo.30	2	9	74	13	4	74
Data.31	1	86	3	4	7	86

Data.32	4	1	3	1	95	95
Data.33	2	4	84	7	5	84
Data.34	3	2	5	90	3	90
SAV.35	2	19	38	25	18	38

4.6.2 Mathematics test for the learners from School A (n = 23)

The statistics relevant to the responses from the learners of School A (n = 23) in the mathematics test are shown in Table 4.20. The mean scores for all the categories from Algebra (Alg.) to Surface Area and Volume (SAV) are 50%, with the highest mean for Data Handling (Data) with a mean of 98,91% and the lowest mean of 50,72 for Transformation Geometry (TrGeo). The mean score for the sum of all the categories in the test (Maths) is 69,87% (mean is greater than 55%), which indicates learners in the six mathematics disciplines was on average satisfactory, considering the fact that the test was a baseline assessment task on grade eleven learning outcomes and assessment standards.

Table 4.20: Descriptive statistics: Alg to Maths - School [A] (n = 23)

	Alg	Trig	AnGeo	TrGeo	Data	SAV	Maths
N	23	23	23	23	23	23	23
Mean	68.12	61.49	87.83	50.72	98.91	52.17	69.87
S.D.	17.75	21.29	16.78	33.14	5.21	51.08	17.08
Minimum	33.33	28.57	40.00	0.00	75.00	0.00	44.92
Quartile 1	56.67	42.86	80.00	33.33	100.00	0.00	57.62
Median	66.67	57.14	100.00	66.67	100.00	100.00	67.14
Quartile 3	80.00	71.43	100.00	66.67	100.00	100.00	82.86
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	100.00

4.6.3 Mathematics test for the learners from School B (n = 26)

The responses from the learners of School B (n = 26) in the mathematics test are shown in Table 4.21. The mean scores for all the categories show that four of the categories are more than 50%, while two of the categories namely Transformation Geometry (TriGeo) and Surface Area and Volume (SAV) have mean scores below 50%. The mean score for the sum of all the categories (Maths) is 54% (mean is less than 55%), which could conclude that the mathematics test was answered on average not satisfactorily if 55% is used as a benchmark, considering the fact that the test was a baseline assessment task on grade eleven learning outcomes and assessment standards.

Table 4.21: Descriptive statistics: Alg to Maths - School [B] (n = 26)

	Alg	Trig	AnGeo	TrGeo	Data	SAV	Maths
N	26	26	26	26	26	26	26
Mean	50.26	50.55	70.00	28.21	90.38	34.62	54.00
S.D.	15.58	15.24	18.11	24.39	18.81	48.52	15.35
Minimum	26.67	28.57	40.00	0.00	25.00	0.00	20.04
Quartile 1	40.00	42.86	60.00	0.00	81.25	0.00	43.17
Median	46.67	42.86	80.00	33.33	100.00	0.00	48.25
Quartile 3	58.33	57.14	80.00	33.33	100.00	100.00	65.40
Maximum	80.00	100.00	100.00	100.00	100.00	100.00	86.35

4.6.4 Mathematics test for the learners from School C (n = 51)

The responses from the learners of School C (n = 26) in the mathematics test are shown in Table 4.22. The mean scores for all the categories show that three of the categories are more than 50%, while three of the categories namely Trigonometry (Trig) Transformation Geometry (TriGeo) and Surface Area and Volume (SAV) have mean

scores below 50%. The mean score for the sum of all the categories (Maths) is 55,20 % (mean is greater than 55%), which could conclude that the mathematics test was answered on average marginally satisfactorily if 55% is used as a benchmark, considering the fact that the test was a baseline assessment task on grade eleven learning outcomes and assessment standards.

Table 4.22: Descriptive statistics: Alg to Maths - School [C] (n = 51)

	Alg	Trig	AnGeo	TrGeo	Data	SAV	Maths
N	51	51	51	51	51	51	51
Mean	52.29	49.58	66.27	46.41	83.33	33.33	55.20
S.D.	16.67	21.45	25.14	24.11	18.48	47.61	13.97
Minimum	26.67	14.29	0.00	0.00	50.00	0.00	31.71
Quartile 1	40.00	42.86	50.00	33.33	75.00	0.00	46.87
Median	46.67	42.86	80.00	33.33	75.00	0.00	53.45
Quartile 3	66.67	57.14	80.00	66.67	100.00	100.00	59.21
Maximum	100.00	100.00	100.00	100.00	100.00	100.00	96.67

4.6.5 Comparative analysis

The responses of the grade twelve learners of the three sample schools are compared and grouped in the following performance ranges namely 0 – 19 (very poor), 20 – 39 (poor), 40 – 60 (average), 61 – 80 (good) and 81 – 100 (very good). The tables below show the different categories of mathematics, and how the learners per sample school are grouped into the different performance ranges. The following performance ranges (61 – 80) and (81 – 100) could be regarded as the areas where the mathematics learners demonstrate good conceptual understanding of the curriculum content under discussion, considering that the learners were assessed on grade eleven content.

- **Comparative analysis of Algebra (Alg)**

The Algebra Category (Alg) scores of the learners of the sample schools are given in the different performance ranges in the Table 4.23. The Algebra consists of fifteen statements (refer to Appendix D) and the scores are collected on the spreadsheets (refer to Appendix D4), which are grouped in the table below. According to the information presented, the learners of School A ($n = 23$) were more effective with $\frac{16}{23}$ learners (70%), followed by School C ($n = 51$) with $\frac{14}{51}$ learners (27%) and then School B ($n = 26$) with $\frac{6}{26}$ (23%).

Table 4.23: School and Alg

School	Alg									
	0 - 19		20 - 39		40 - 60		61 - 80		81 - 100	
School A	0	0%	2	9%	5	22%	13	57%	3	13%
School B	0	0%	4	15%	16	62%	6	23%	0	0%
School C	0	0%	10	20%	27	53%	13	25%	1	2%
Total	0	0%	16	16%	48	48%	32	32%	4	4%

- **Comparative analysis of Trigonometry (Trig)**

The Trigonometry Category (Trig) scores of the learners of the sample schools are given in the different performance ranges in the Table 4.24. The Trigonometry consists of seven statements (refer to Appendix D) and the scores are collected on the spreadsheets (refer to Appendix D4), which are grouped in the table below. According to the information presented, the learners of School A ($n = 23$) were more effective with $\frac{11}{23}$

learners (48%), followed by School C (n = 51) with $\frac{12}{51}$ learners (24%) and then School B (n = 26) with $\frac{3}{26}$ (12%).

Table 4.24: School and Trig

School	Trig									
	0 - 19		20 – 39		40 – 60		61 - 80		81 – 100	
School A	0	0%	2	9%	10	43%	6	26%	5	22%
School B	0	0%	3	12%	20	77%	2	8%	1	4%
School C	5	10%	7	14%	27	53%	7	14%	5	10%
Total	5	5%	12	12%	57	57%	15	15%	11	11%

- **Comparative analysis of Analytical Geometry (AnGeo)**

The Analytical Geometry Category (AnGeo) scores of the learners of the sample schools are given in the different performance ranges in the Table 4.25 and show the same scores as the Trigonometry Category (Trig). The Analytical Geometry consists of five statements (Appendix D) and the scores are collected on the spreadsheets (Appendix D4), which are grouped in the table below. According to the information presented the learners of School A (n = 23) were more effective with $\frac{11}{23}$ learners (48%), followed by School C (n = 51) with $\frac{12}{51}$ learners (24%) and then School B (n = 26) with $\frac{3}{26}$ (12%).

Table 4.25: School and AnGeo

School	AnGeo									
	0 - 19		20 – 39		40 - 60		61 - 80		81 - 100	
School A	0	0%	2	9%	10	43%	6	26%	5	22%
School B	0	0%	3	12%	20	77%	2	8%	1	4%
School C	5	10%	7	14%	27	53%	7	14%	5	10%
Total	5	5%	12	12%	57	57%	15	15%	11	11%

- **Comparative analysis of Transformation Geometry (TrGeo)**

The Transformation Geometry Category (TrGeo) scores of the learners of the sample schools are given in the different performance ranges in the Table 4.26. The Transformation Geometry consists of three statements (refer to Appendix D) and the scores are collected on the spreadsheets (refer to Appendix D4), which are grouped in the table below. According to the information presented, the learners of School A (n = 23) were more effective with $\frac{20}{23}$ learners (87%), followed by School B (n = 26) with $\frac{14}{26}$ learners (54%) and then School C (n = 26) with $\frac{17}{51}$ (53%) very close with a difference of 1%.

Table 4.26: School and TrGeo

School	TrGeo									
	0 - 19		20 - 39		40 - 60		61 - 80		81 – 100	
School A	0	0%	0	0%	3	13%	7	30%	13	57%
School B	0	0%	0	0%	12	46%	11	42%	3	12%
School C	1	2%	4	8%	19	37%	19	37%	8	16%
Total	1	1%	4	4%	34	34%	37	37%	24	24%

- **Comparative analysis of Data Handling (Data)**

The Data Handling Category (Data) scores of the learners of the sample schools are given in the different performance ranges in the Table 4.27. The Data Handling consists of four statements (refer to Appendix D) and the scores are collected on the spreadsheets (refer to Appendix D4), which are grouped in the table below. According to the information presented, the learners of School A ($n = 23$) were more effective with $\frac{12}{23}$ learners (52%), followed by School C ($n = 51$) with $\frac{23}{51}$ learners (45%) and then School B ($n = 26$) with $\frac{3}{26}$ (12%).

Table 4.27: School and Data

School	Data									
	0 - 19		20 - 39		40 - 60		61 - 80		81 - 100	
School A	0	17%	7	30%	0	0%	8	35%	4	17%
School B	0	31%	15	58%	0	0%	2	8%	1	4%
School C	0	10%	23	45%	0	0%	21	41%	2	4%
Total	0	17%	45	45%	0	0%	31	31%	7	7%

- **Comparative analysis of Surface Area and Volume (SAV)**

The Surface Area and Volume Category (SAV) scores of the learners of the sample schools are given in the different performance ranges in the Table 4.28. The Surface Area and Volume consists of only one statement (refer to Appendix D) and the scores are collected on the spreadsheets (refer to Appendix D4), which are grouped in the table below. According to the information presented, the learners of School A ($n = 23$)

were more effective with $\frac{12}{23}$ learners (52%), followed by School B (n = 26) with $\frac{9}{26}$ (35%) and School C (n = 51) with $\frac{17}{51}$ learners (33%), very close with a difference of 2%.

Table 4.28: School and SAV

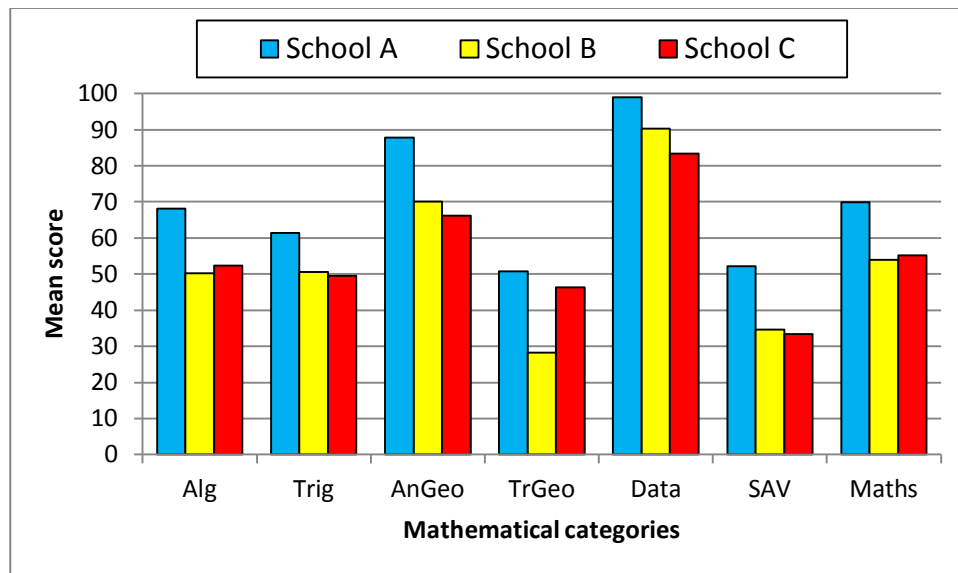
School	SAV									
	0 - 19		20 - 39		40 - 60		61 - 80		81 - 100	
School A	11	48%	0	0%	0	0%	0	0%	12	52%
School B	17	65%	0	0%	0	0%	0	0%	9	35%
School C	34	67%	0	0%	0	0%	0	0%	17	33%
Total	62	62%	0	0%	0	0%	0	0%	38	38%

- **Comparative analysis of Mathematics (Maths)**

The mean mathematical scores for all the Mathematical Categories are presented in Figure 4.7. The graph shows that School A obtained the highest mean score for all the Mathematical Categories (Maths) with a mean score of 69,87%, followed by School C with a mean score of 55,20% and followed closely by School B with a mean score of 54,0%. The graph also shows that the mean scores of School A are the highest amongst the three schools for all the Mathematical Categories, followed by School C and lastly by School B. It could therefore be argued by taking the mean scores into consideration, that the achievement of the learners of School A was satisfactory. This is followed by School C, whose performance was average, considering that this school is most poorly resourced and its sample size is approximately twice the size of the other two schools. The learner performance of School B was the poorest of the three sample schools. School B also shows a lot of similarity with School A in terms of sample size, number of teachers and

learners, resources etc, but failed to deliver the same learner performance in the mathematics test as School A.

Figure 4.7: Mean mathematical scores by school



4.7 SUMMARY

The responses of (a) firstly all the teachers ($n = 100$) of the sample schools on their Collective Efficacy (CE) through a Likert-scale questionnaire (b) only the mathematics teachers ($n = 6$) through a questionnaire on their Teacher Self-Efficacy (TSE) with two options in terms of their preference of choice (c) only the mathematics teachers ($n = 6$) who teach the grade eleven core syllabus through semi-structured interviews and (d) grade twelve mathematics learners ($n = 100$) of the sample schools

who answered a multiple-choice mathematics test on the grade eleven core syllabus, are summarized in the sequential categories below.

4.7.1 Collective efficacy (CE) of all the teachers (n = 100)

The Collective efficacy (CE) data from all the teachers (n = 100), both mathematics and non-mathematics teachers were analyzed quantitatively by the Unit for Statistical Consultation at the Nelson Mandela Metropolitan University. The descriptive data that are presented as tables, graphs and text, show that on average (mean = 2,89), the collective efficacy beliefs of the teachers of the sample schools had a tendency towards the positive for all the categories (CE1 to CE6), as all the categories have mean scores greater than 2,60 (refer to Table 4.6).

The CE data for all the teachers are summarized as per sample school. The categories include all the facets of the school which impact on teaching, learning and assessment strategies, and which consequently lead to the academic achievement of the learners. The categories (CE) include CE1 (The Effectiveness of the School), CE2 (The Attitude of the Learners), CE3 (Classroom Practice), CE4 (Teaching, Learning and Assessment), CE5 (Professional Development and Support) and CE (Leadership and Management).

- **School A (n = 32)**

The teachers of School A (n=32) were overall more positive (mean = 3,33) in their collective efficacy beliefs with a mean score for all the categories (CE1 to CE6) greater than 2,60.

- **School B (n = 36)**

The teachers of School B (n=36) were overall more negative (mean = 2,34) in their collective efficacy beliefs with a mean score for all the categories (CE1 to CE6) less than 2,60.

- **School C (n = 32)**

The teachers of School C (n=32) were overall most positive (mean = 3,54) in their collective efficacy beliefs with a mean score for all the categories (CE1 to CE6) greater than 2,60.

4.7.2 Teacher self-efficacy (TSE) of all the mathematics teachers (n = 16)

The Teacher self-efficacy (TSE) data from all the mathematics teachers was analyzed quantitatively by the Unit for Statistical Consultation at the Nelson Mandela

Metropolitan University and the descriptive data that are presented as tables, graphs and text are summarized coherently as follows:

- **School A (n = 5)**

The teachers of School A (n = 5) were overall more positive as $\frac{12}{25}$ of the statements that were scored by the teachers showed a score marginally less than 50% in favour of the mathematics teacher. These teachers were moderate in their self-efficacy scores as just under 50% of the statements (48,0%) were scored in favour of the teacher to be in control of the learning environment (internal control) as opposed to the influence of external factors of 52,0% (external control). The TSE mean score was 47,2% which was the second highest of the three sample schools.

- **School B (n = 6)**

The teachers of School B (n = 6) were overall more negative as $\frac{7}{25}$ statements that were scored by the teachers showed a score less than 50% in favour of the mathematics teacher. These teachers were less self-efficacious as more than 50% of the statements (72,0%) were scored in favour of external factors to be in control of the learning environment (external control) as opposed to the influence of the teacher 28,0% (internal control). The TSE mean score was 44,0% which was the lowest of the three sample schools.

- **School C (n = 5)**

The teachers of School C (n = 5) were overall more positive as $\frac{15}{25}$ statements that were scored by the teachers showed a score greater than 50% in favour of the mathematics teacher. These teachers were more self-efficacious as more than 50% of the statements (60,0%) were scored in favour of the teacher to be in control of the learning environment (internal control) as opposed to the influence of external factors of 40,0% (external control). The TSE mean score was 56,8% which was the highest of the three sample schools.

4.7.3 Summary of semi-structured interviews (n = 6)

The discussion of the semi-structured interviews is done comparatively according to the three themes in order to identify certain patterns from the themes, firstly to compare the mathematics efficacy of the mathematics teachers according to the themes, and secondly to make comparisons across the themes in order to draw comparisons with the quantitative data in the final chapter.

- **Theme 1: Teachers' understanding of the concept of outcomes-based education**

The mathematics teachers of **School A** showed good understanding of what they perceive outcomes-based education to be, but could not motivate the difference

outcomes-based education has made on the conceptual understanding of mathematics by learners. Both teachers showed frustration in the implementation process of outcomes-based education in the NCS curriculum, because of various educational hindrances.

The teachers of **School B** explained the concept of outcomes-based education relatively satisfactorily. The implementation process of outcomes-based education in terms of the teaching, learning and assessment strategies is problematic, because of factors which include improper teaching techniques, non-participation of learners and unclear assessment guidelines.

The teachers of **School C** were also clear in their understanding of what the concept of outcomes-based education means. Both these teachers showed frustration in implementing the process effectively due to a range of contextual factors and also negative learning attitudes demonstrated by learners.

- **Theme 2: Teachers' understanding of a new curriculum statement (NCS) in mathematics**

The teachers of **School A** showed good understanding of the changes in the NCS curriculum. The teachers mentioned that the changes in the new curriculum brought in easier topics as well as more difficult ones, and agreed that the new curriculum is more cognitively challenging than the old NATED 550 curriculum. Both the teachers felt that the mathematics in the new curriculum is not different in the manner in which learners

understand mathematics when compared with the old NATED 550 curriculum. The changes in the NCS curriculum, according to the two teachers had a negative impact on the results of their grade eleven learners in the external examination of the previous year.

The teachers of **School B** correctly identified some of the significant changes of the NCS curriculum. The teachers were not assertive on whether the changes had an impact on the level of understanding of mathematics by the learners. The teachers also agreed that the work in the new curriculum is more difficult than the old NATED 550 curriculum, and as a consequence had a negative impact on the results of their grade eleven learners in the final external examination of the previous year.

The teachers of **School C** showed a good understanding of the changes that were introduced in the NCS curriculum. The two teachers were reluctant to commit themselves openly on whether the changes had an impact on the conceptual understanding of mathematics by learners. Both teachers agreed that the mathematics in the new curriculum is more demanding than the old NATED 550 curriculum, and as a result made their grade eleven learners under-achieve in the final external examination of the previous year.

- **Theme 3: Teachers' expositions of mathematics in the schools where they teach**

The teachers of **School A** expressed their confidence in the commitment of their mathematics teachers. They were however divided on the issue of who should be held accountable for poor results in mathematics - the teachers or the learners? The two teachers also disagreed on the effectiveness of support structures that are supposed to help learners who are struggling with mathematics. Both teachers felt that they would get better results in mathematics if the Education Department provides better curriculum and material support.

The teachers of **School B** mentioned that the commitment of their mathematics teachers was never in doubt, but the dedication of their learners was. The teachers felt that both teachers and learners should be held accountable for poor results. Both teachers had their reservations about the effectiveness of extra classes given to learners. The mathematics teachers felt that they would get better results in a more affluent school, because the necessary structures are in place to assist them in these schools, which are absent or dysfunctional in their current school.

The teachers of **School C** expressed the view that although their teachers teach under very difficult conditions, their mathematics teachers always showed commitment and resilience. The two teachers felt that both teachers and learners should be held accountable for poor results. Both the teachers were not happy with the intervention by

education stakeholders, as it was not helpful to learners who are really struggling with mathematics. Both the teachers agreed that the socio-economic status of a school is of little significance, if you have qualified and committed teachers in front of a class teaching learners who are dedicated towards their schoolwork.

4.7.4 Mathematics test (Maths) for all the learners (n = 100)

The data for the mathematics test for the learners was analyzed quantitatively by the Unit for Statistical Consultation at the Nelson Mandela Metropolitan University and the descriptive data that are presented as tables, graphs and text are summarized accordingly. The categories of the mathematics test include all the prescribed mathematics disciplines which include Algebra (Alg), Trigonometry (Trig), Analytical Geometry (AnGeo), Transformation Geometry (Tr.Geo), Data Handling (Data) and Surface Area and Volume (SAV).

- **School A (n = 23)**

The grade twelve learners of School A (n = 23) responded positively with a mean score across all mathematical disciplines of 69,87%, taking into consideration that the questions were based on the grade eleven core work schedule. This mean score shows that the academic achievement of the learners in terms of their conceptual understanding across all the mathematical disciplines is above average.

- **School B (n = 26)**

The grade twelve learners of School B (n = 26) responded negatively with a mean score across all mathematical disciplines of 54,0%, taking into consideration that the questions were based on the grade eleven core work schedule. School B in comparison with School A shows similarity in sample size, resources at the schools and socio-economic conditions surrounding the schools, and it could therefore be concluded that the academic achievement of learners in terms of their conceptual understanding across all the mathematical disciplines is poor, when compared to School A and even School C.

- **School C (n = 51)**

Although School C is, in comparison with the other two sample schools, most poorly resourced and the sample size more than twice the sample size of School A and School B, the grade twelve mathematics learners (n = 51) still manage to get a mean score of 55,20%. The learners responded positively to the test, taking into consideration the number of learners as compared to the other two sample schools, the adverse socio-economic conditions surrounding the school and other contextual factors and also comparing their scores with School B, which is far better resourced and has fewer mathematics learners than School C. It could therefore be concluded, taking the above factors into consideration that the academic achievement of the learners across all the mathematical disciplines is average, which could have been worse if it were not for the

positive collective efficacy relations of all the teachers in the school and the highly self-efficacious teachers in the mathematics classrooms of the school.

4.8 CONCLUSION

The presentation and the analysis of the results of the study are based on quantitative and qualitative data collected from both teachers and learners. The consistency of both types of data for this study is within acceptable ranges for social sciences research. The quantitative data was analyzed independently by the Unit for Statistical Consultation at the Nelson Mandela Metropolitan University, by using multi-item analysis, and the data show consistency in that the Cronbach alpha coefficient for the multiple item analysis falls within acceptable ranges for consistency. The qualitative data show consistency in that the interviews are the transcripts of the verbal responses of the mathematics teachers, analyzed and then summarized according to the themes of the interviews.

The results of the study which are presented as tables, graphs and text attempt to give answers to the primary and the sub-ordinate research questions of the study. The manner in which the analysis and the interpretation of the data was done is in the same sequence of the sub-ordinate research questions, which in its combination attempts to address the primary research question.

The instruments that were used to collect data on collective efficacy of all the teachers and self-efficacy of the mathematics teachers (refer to Appendices A and B) have been adapted from instruments previously used in efficacy research. The transcriptions from the digital recordings (refer to Appendix C3) in the text are the word by word descriptions of the mathematics teachers. The mathematics test that was written by the learners was quality assured by the Department of Education (refer to Appendix F), by which the test was approved in terms of the coverage of the relevant learning outcomes and assessment standards.

The analysis of the quantitative data, using computer software by an independent service provider and the consistency ranges of the data have to deem the analysis objective, and free from any interference. The analysis and the discussion of the qualitative data according to how the themes revealed themselves are the descriptions of the real-life situations in which these mathematics teachers find themselves.

All the ethical procedures and requirements for research have been complied with in terms of permission granted by the respondents, through Head Office, Eastern Cape Department of Education (refer to Appendix G) and also through the East London District Office (refer to Appendix H), where the sample schools are located. An ethical clearance letter from the Nelson Mandela Metropolitan University (refer to Appendix I), also gives evidence that the requirements for research in terms of this type of study have been complied with.

The permission from the respondents to gather data, the instruments that were used to analyze the data, the consistency of the data, the analysis of the quantitative data presented as tables and graphs, and also the analysis and discussion of the interviews, give evidence that the manner in which the data have been presented, discussed and analyzed in this chapter are credible, valid and reliable as they attempt to answer the primary and sub-ordinate questions of this study.

CHAPTER FIVE

RESEARCH FINDINGS

5.1 INTRODUCTION

The research findings are presented in a qualitative paradigm, because this study mainly focuses on perceptions and perspectives of teachers. The research findings that are presented in this chapter are based on the analysis of the data which are presented in chapter four. The analysis of the data has shown acceptable consistency for both quantitative and qualitative data. The research findings of both the quantitative and qualitative data that were used in this study are presented as text.

Firstly, the results presented in chapter four are discussed within the context of the theoretical framework developed in chapter two and guided by the research question and sub-ordinate questions noted in chapter one. By interpreting the data generated by this study, the research findings will indicate whether existing theoretical frameworks are supported or falsified.

After the summary of the research findings has been presented, general conclusions are then drawn, within the context of the study and the limitation of the research question.

5.2 DISCUSSION OF QUANTITATIVE AND QUALITATIVE DATA

The discussion of the quantitative data is done within the limitations of using descriptive statistics in social sciences research, as descriptive statistics are merely used to *describe* the data of one single group. The discussion of the data is therefore limited to the sample of this study, which includes the responses of both teachers and learners of the sample schools. The findings of the study cannot be generalized to a larger population as no inferential statistics were used to *infer* properties about a large population from a smaller sample.

The discussion of the qualitative data of the semi-structured interviews is done from the transcriptions of the interviews as they revealed themselves within the different themes. The qualitative data are used to confirm certain patterns in the quantitative data, which is descriptive in nature, and not to make generalizations about a larger population.

The discussion of both the quantitative and qualitative data attempts to answer the primary research question of this study, and is presented in the same sequence as the subordinate questions revealed themselves in chapter one. The discussion of the research findings in this chapter includes both the analysis of the quantitative data and the analysis and summary of qualitative data as it was presented in chapter four, in the following sequence: the Collective Efficacy (CE) descriptive statistics, the Teacher Self-Efficacy (TSE) descriptive statistics, the semi-structured interviews and the Mathematics (Maths) Test descriptive statistics.

5.3 RESEARCH FINDINGS OF CE DESCRIPTIVE STATISTICS

The research findings of the descriptive statistics provide explanations relevant to the data presentation, discussion and the analysis of the data as presented in chapter four.

The analysis of the quantitative collective efficacy (CE) data, using STATISTICA computer software and the Cronbach's alpha coefficient by using multi-item analysis, have rendered the research findings described in this chapter. The research findings of this study are based on the responses of all the teachers of the sample schools, who were surveyed (refer to Appendix A1) on their perceptions and perspectives of their respective schools regarding the relationship between the management practices and the curriculum delivery processes of these schools. The different categories on the questionnaire (refer to Appendix A) included the following categories, namely Category 1: *The Effectiveness of the School*, Category 2, *The Attitude of the Learners*, Category 3, *Classroom Practice*, Category 4, *Teaching Learning and Assessment*, Category 5, *Professional Development and Support* and Category 6, *Leadership and Management*. The following research findings are made based on the analysis of the responses by the teachers as presented in chapter four.

The teachers of **School A (n = 32)** were overall *more positive* (mean = 3,33) than negative in their collective efficacy beliefs with a mean score for all the categories (CE1 to CE6) greater than 2,60.

The teachers of **School B (n = 36)** were overall *more negative* (mean = 2,34) than positive in their collective efficacy beliefs with a mean score for all the categories (CE1 to CE6) less than 2,60.

The teachers of **School C (n = 32)** were overall *most positive* (mean = 3,54) of the three sample schools in their collective efficacy beliefs with a mean score for all the categories (CE1 to CE6) greater than 2,60.

5.4 RESEARCH FINDINGS OF TSE DESCRIPTIVE STATISTICS

Based on the data presentation, discussion and the analysis of the data in chapter four, the research findings of the teacher self-efficacy (TSE) data are presented.

The research findings in this chapter is based on the analysis of the responses by the mathematics teachers (refer to Appendix B2) of the sample schools in terms of their perspectives of the influence of the mathematics teacher (internal control) over their learners as opposed to factors outside the control of the mathematics teacher (external control).

Two opposing statements namely where the mathematics teachers are in control (internal control = 1) and factors outside the control of the mathematics teacher (external control = 0) influence the curriculum delivery processes were analyzed. The analysis using STATISTICA software, show that the data were consistent according to the

Cronbach alpha coefficient ranges for internal consistency, as was mentioned in chapter four.

The teachers of **School A (n = 5)** were overall more positive as $\frac{12}{25}$ or 48% of the statements that were scored by the teachers showed a score marginally less than 50% in favour of the teacher. The TSE mean score was 47,2% which was the second highest of the three sample schools. The teachers therefore showed marginal *positive self-efficacy* beliefs in favour of the internal control statements, where the influences of the teachers outweigh the influence of factors outside the control of the teacher or external factors.

The teachers of **School B (n = 6)** were overall more negative as $\frac{7}{25}$ or 28% of the statements that were scored by the teachers showed a score less than 50% in favour of the teacher. The TSE mean score was 44,0% which was the lowest of the three sample schools. The teachers therefore showed high *negative self-efficacy* beliefs in favour of the external control statements, where the factors outside the control of the teacher outweigh the influence of the teacher over the curriculum delivery processes.

The teachers of **School C (n = 5)** were overall more positive as $\frac{15}{25}$ or 60% of the statements that were scored by the teachers showed a score greater than 50% in favour of the teacher. The TSE mean score was 56,8% which was the highest of the three sample schools which is also greater than the TSE mean score of 49,0 by all the

teachers. The teachers therefore showed high *positive self-efficacy* beliefs in favour of the internal control statements, where the influences of the teachers outweigh the influence of factors outside the control of the teacher or external factors.

5.5 INTERPRETATION OF THE SEMI-STRUCTURED INTERVIEWS

The interview data from the mathematics teachers that were firstly recorded and then transcribed (refer to Appendix C3) are interpreted in the different themes as was revealed during the interviews. The interpretation of the findings is presented as per school in order to draw certain comparisons in terms of how the teachers responded to the themes under discussion.

5.5.1 School A (n = 2)

Both the teachers were clear on their understanding of *outcomes-based education* being in the interest of the learner, but having practical problems in implementing effective teaching, learning and assessment strategies.

A good understanding of a *new curriculum statement (NCS)* is also evident from the mathematics teachers who are well-informed about the curriculum changes in mathematics and their possible cognitive challenges for both teachers and learners.

In terms of *teachers' expositions* of mathematics, the teachers are positive about the influence they can exert over their learners in order to bring about positive change in the mathematics classroom, but are also aware of the negative influence of external factors that could possibly hamper effective teaching, learning and assessment strategies. One teacher takes responsibility for the results in mathematics, while the other teacher blames it on negative learning attitudes.

According to the responses of the interviews by the teachers of School A, these two teachers showed marginal *positive self-efficacy beliefs* in terms of their expositions towards mathematics.

5.5.2 School B (n = 2)

The teachers do exhibit a good understanding of *outcomes-based education*, but are also very clear about what the challenges are in terms of effective curriculum delivery in the mathematics classroom.

The teachers also show a good understanding of the *new curriculum statement* and express good insight into which areas the learners find mathematics more demanding, and are also expressive in terms of their own challenges in completing the work schedule in good time.

The *teachers' expositions* of mathematics by the two teachers show a clear acknowledgement that the poor results of mathematics in the school are partly to be blamed on the teacher but also the negative learning attitude of the learners. Another area of concern is that both teachers suggest that they will get better results at a more affluent school, admitting that negative external factors in the school outweigh their influence on learning in the mathematics classroom. This suggestion could also subtly imply that if the school functions better as it is currently doing, then the mathematics achievement of learners as a consequence could also be improved.

According to the responses of the interviews by the teachers of School B, these two mathematics teachers showed high *negative self-efficacy beliefs* in terms of their expositions towards mathematics.

5.5.3 School C (n = 2)

Both the teachers gave a concise and clear explanation of *outcomes-based education* namely that it must be learner-centred and aim to develop the child in totality, but are also very critical with the implementation strategies in terms of teaching, learning and assessment.

The teachers also understand the changes in the *new curriculum statement (NCS)* very well, and are also aware of both the positive and negative cognitive challenges these

changes bring to the mathematics classroom and when their learners have to sit for final external examinations.

Both the teachers show positive attitudes in terms of the *expositions of mathematics*, irrespective of poor resources inside the school, adverse socio-economic conditions surrounding the school and other contextual factors. Both the mathematics teachers believe that good mathematics results depend on good teachers and dedicated learners, suggesting that the influence of the mathematics teacher in the classroom can exert more influence on learning than the negative external factors, irrespective of the school. Both teachers admit that teachers and learners should be held accountable for poor results.

According to the responses of the interviews by the teachers of School C, these two teachers showed high *positive self-efficacy beliefs* in terms of their expositions towards mathematics.

5.6 RESEARCH FINDINGS OF THE MATHEMATICS TEST

The data of the mathematics test (refer to Appendix D4) that was done by the grade twelve learners of the sample schools were analyzed and have shown acceptable consistency for multi-item analysis in terms of the Cronbach alpha coefficient ranges. The data presentation, discussion and analysis of the data in chapter four form the basis for the research findings presented in this chapter. The grade twelve mathematics learners

were assessed about their conceptual understanding in all the mathematics disciplines in the grade eleven curriculum (refer to Appendix D), where the learners had to choose the correct answer out of a possible four options. The benchmark for the mean of the test for all the mathematics learners at their respective sample schools was set at 55%, considering that they have to use this conceptual knowledge in their routine application techniques to solve their daily grade twelve mathematics problems.

The grade twelve learners of **School A (n = 23)** responded *positively* with a mean score across all mathematical disciplines of 69,87% well above the benchmark of 55%, taking into consideration that the questions were based on the grade eleven core work schedule.

The grade twelve learners of **School B (n = 26)** responded *negatively* with a mean score across all mathematical disciplines of 54,0% which is below the benchmark of 55%, taking into consideration that the questions were based on the grade eleven core work schedule.

School C (n = 51), in comparison with the other two sample schools, the poorest of the three sample schools and the sample size more or less twice that of School A and School B, still managed to get a mean score of 55,20% which is marginally above the benchmark of 55% across all the mathematical disciplines, hence showing better results than School B. The learners therefore responded better to the test as School B, irrespective of the contextual factors that could have made their results much worse. The

mathematics learners of School C therefore responded *positively* under very difficult circumstances, with more learners and despite being a school that is very poorly resourced.

5.7 SUMMARY OF THE RESEARCH FINDINGS

The summary of the research findings present the different efficacy relations of both mathematics and non-mathematics teachers of the sample schools and the consequential impact it has on the conceptual understanding of mathematics by their learners.

- **School A**

All the teachers showed positive collective efficacy (CE) beliefs with a mean score of 3,33 out of a maximum of 5 which was the second highest average of the three sample schools. The mathematics teachers showed marginal positive teacher self-efficacy (TSE) beliefs with 48% of the twenty five statements in favour of the influence of the mathematics teacher over his/her learners, and a second highest mean score of 47,2%. The two grade eleven mathematics teachers who were interviewed also showed marginal positive self-efficacy positive beliefs, as they were consistently aware of the contextual factors that hinder effective teaching, learning and assessment strategies. The grade twelve learners responded positively in the grade eleven mathematics test with a mean score of 69,87 which was the highest average of the three sample schools.

- **School B**

All the teachers of School B showed negative collective (CE) beliefs with a mean score of 2,34 out of a maximum of 5 which was the lowest average of the three sample schools. The mathematics teachers of the school showed negative teacher self-efficacy (TSE) beliefs as 28% of twenty five statements were scored in favour of the influence of the teacher in favour of the curriculum processes, and a mean score of 44,0% which was the lowest average of the three sample schools. The two mathematics teachers who were interviewed also showed negative self-efficacy beliefs in terms of their expositions towards mathematics. The grade twelve learners responded negatively in the grade eleven mathematics test with a mean score of 54,0% which was the lowest average of the three sample schools.

- **School C**

All the teachers of School C showed positive collective (CE) beliefs with a mean score of 3,54 out of a maximum of 5 which was the highest average of the three sample schools. The mathematics teachers showed positive teacher self-efficacy (TSE) beliefs with 60% of the twenty five statements in favour of the influence of the mathematics teachers over their learners as opposed to external factors outside the control of the teacher. The two grade eleven mathematics teachers who were interviewed showed positive teacher self-efficacy beliefs in terms of their expositions towards mathematics regarding their teaching, learning and assessment strategies. The grade twelve learners

responded positively in the grade eleven mathematics test with a mean score of 55,20% which was the second highest average of the three sample schools.

5.8 COMPARITIVE SUMMARY OF THE SAMPLE SCHOOLS

Comparisons are made between School A and School B, because these schools are more or less equally resourced, have the same number of teachers and learners and also have more or less the same number of teachers and learners in the sample for this study.

The teachers of School A showed positive collective efficacy (CE) beliefs with a mean score of 3,33 as opposed to those of School B with a negative collective efficacy (CE) mean score of 2,34. The mathematics teachers of School A also showed marginal positive teacher self-efficacy (TSE) beliefs of 48% of the statements scored in favour of the mathematics as opposed to School B with negative teacher self-efficacy (TSE) beliefs with 28% of the statements scored in favour of the mathematics teacher. The two mathematics teachers of School A who were interviewed showed positive teacher self-efficacy beliefs towards mathematics as opposed to School B who showed negative teacher self-efficacy beliefs. The grade twelve mathematics learners of School A also performed better in the grade eleven mathematics test with a mean score of 69,87 as opposed to School B with a mean score of 54,0%.

By comparing two similar schools in terms of socio-economic conditions, staffing and enrolment of learners, the effect of collective efficacy on teacher self-efficacy and

conceptual understanding of mathematics by mathematic learners in these two schools becomes evident. It is clear in the analysis that the teachers of School A are more positive in their collective efficacy beliefs than the teachers of School B, hence influencing the teacher self-efficacy and mathematics efficacy of the mathematics teachers, and therefore the conceptual understanding of mathematics by the mathematics learners of School A is far better than the mathematics learners of School B.

The next comparison is made between School B and School C, because School C is the poorest school of the three sample schools with minimum resources, having more or less the same number of teachers but more learners and the number of the learners in the sample is more or less twice that of the other two sample schools.

Although School C is the poorest of the three sample schools, the teachers showed positive collective efficacy (CE) beliefs with a mean score of 3,54 the highest average amongst the sample schools as opposed to School B whose teachers showed negative collective efficacy (CE) beliefs with a mean score of 2,34, which is the lowest average of the sample schools. The mathematics teachers of School C were more positive than the mathematics teachers of School B, with 60% of the statements scored in favour of the mathematics teacher exerting influence over the curriculum delivery processes as opposed to 28% of the statements scored in favour of the mathematics teacher by the mathematics teachers of School B. The two grade eleven mathematics teachers of School C who were interviewed also showed positive teacher self-efficacy beliefs towards the exposition of mathematics as opposed to negative teacher self-efficacy beliefs showed by

the two grade eleven mathematics teachers of School B. The grade twelve mathematics learners of School C responded marginally better than School B with a mean score of 55,20% as opposed to the mean score of 54,0% of School B.

By comparing two schools with different socio-economic conditions and learner enrolment, the effect of collective efficacy on learner performance can be seen as a buffer preventing a very poorly resourced school from collapsing into a dysfunctional learning institution. Although School C is much poorer than School B, less resourced with more learners and a sample size more or less twice the size of the other two sample schools, the expectation is that the performance of those learners will be less than that of School B. It is proven in this study that it is not the case, in the sense that positive collective efficacy beliefs of the teachers in School C as opposed to the negative collective efficacy beliefs in School B, have influenced the teacher self-efficacy and the mathematics efficacy of the mathematics teachers, and therefore have made learners understand the concepts in mathematics better in School C than in School B, despite the contextual factors faced by School C.

5.9 CONCLUSION

The research findings that have been presented in this chapter lay the foundation for answering the primary and sub-ordinate questions of this study. The fact that this is an ethnographic study, where qualitative data were used to probe the ‘insider worlds’ of teachers and descriptive statistics in the analysis of the quantitative data, limits the

research findings only to the description of the data and not to any generalization of a greater population.

Certain comparisons were drawn firstly from the research findings in terms of effect of collective efficacy on curriculum implementation in a particular school, and then across the three sample schools. The use of quantitative data instruments (questionnaires and the mathematics test) and qualitative data instruments (interviews), which have shown acceptable consistency ranges in its analysis, have lent credibility to the research findings to be valid and reliable. Cohen, Manion and Morrison (2000:105) describe *validity* as a demonstration that a particular instrument, in fact, measures what it purports to measure, while in qualitative data might be addressed through the honesty, depth, richness and scope of the data achieved. For research to be *reliable* it must be demonstrated that if it were carried out on a similar group of respondents in a similar context, then similar results would be found (Cohen *et al.*, 2000:105).

The comparisons in the different schools have shown certain patterns where teachers' perceptions and perspectives of their respective schools were positive, the mathematics teachers felt more in control over the teaching, learning and assessment processes in the classroom, hence contributing to a better understanding of mathematics by the learners. The study has also shown where teachers are negative about their school, mathematics teachers feel less in control over the teaching, learning and assessment processes in their school, which contributes to a lack of conceptual understanding of mathematics by learners.

The effect of collective efficacy on curriculum implementation is evident when a comparison is made between two schools which are equally resourced, but the mathematics learners in the one school show better conceptual understanding than the mathematics learners in the other school. This research finding lays the foundation to answer the primary and the sub-ordinate questions of this study.

The effect of collective efficacy on curriculum implementation is even more evident when an average resourced school is compared with a very poorly resourced school, and where the mathematics learners of the poorly resourced school outsmart the learners in the better resourced school. The context of this study is schools that are situated in previously disadvantaged communities, hence confirming previous research on the topic that the self-perceptions of teachers in a particular school can override the socio-economic surroundings of that school.

These research findings are used as a framework to summarize the entire research process in the next chapter in order to review the research aim and the research objectives of the research topic.

CHAPTER SIX

SUMMARY, RECOMMENDATIONS AND CONCLUSION

6.1 INTRODUCTION

The summary of this chapter is presented *mainly* in terms of data analysis in chapter four and the research findings in chapter five of this study. The summary also reflect previous efficacy research, theoretical definitions and statements developed by Brinson and Steiner (2007:1) which states that *collective efficacy* is the perception of teachers in a school that the efforts of the institution as a whole will have a positive impact on student learning. Henson (2001:4), as part of the theoretical framework of this study, defines teacher *self-efficacy* as a teacher's judgment of his/her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated.

The answers to the sub-ordinate questions are important considerations when drawing conclusions from this study. The conclusions that are drawn are relevant within the context of this research which investigates the effect of collective efficacy on curriculum implementation, by giving answers within the limitations of this study.

Recommendations are made in terms of strategies to improve mathematics results, through effective curriculum management and curriculum implementation practices in the sample schools, as are recommendations for further research in mathematics education and the effective teaching, learning and assessment of school mathematics. The limitation of this study is also outlined within the context of the specific research design used, as well as suggestions for further research on the research topic.

Specific conclusions are firstly drawn in terms of what this research has accomplished by using the research findings to reflect on the research aim and research objectives which were set in the initial stages of this study. Finally general conclusions are drawn, which are based on the specific conclusions, in order to provide an alternative perspective to increase learner attainment in mathematics.

6.2 RELEVANCE OF THE RESEARCH FINDINGS TO THE RESEARCH QUESTIONS

The relevance of the research findings to the research questions focuses on answering firstly the sub-ordinate questions and then, based on those responses answer the primary research question. The answers of whether this study supports or falsifies previous research are dealt with in the context of previous research developed by Brinson and Steiner (2007:1). This research states that *collective efficacy* is the perception of teachers in a school that the efforts of the institution as a whole will have a positive impact on student learning, are important considerations. Henson (2001:4) who defines

teacher *self-efficacy* as a teacher's judgment of his/her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated, also provides a theoretical framework in which these questions are answered.

Do the research findings give answers to the sub-ordinate questions of this study and ultimately answer the primary research question?

The sub-ordinate questions are answered in the same sequence as they were posed in chapter one and read as follows:

- To what extent does collective efficacy affect the perceptions and perspectives of all teachers, both mathematics teachers and non-mathematics teachers, that the curriculum changes could be implemented effectively?

Based on the analysis and the research findings, the effect of collective efficacy is significant when considering the adverse socio-economic conditions of the sample schools. The responses of the all the teachers from the sample schools (refer to Appendix A1) have shown different collective efficacy beliefs about the collective efficacy categories as clearly illustrated by Figure 4.1. These different responses in terms of how these teachers have scored the different categories on the questionnaire (refer to Appendix A), were influenced by their collective efficacy beliefs of their respective

schools, hence influencing the perceptions and perspectives of these teachers regarding effective implementation of curriculum changes.

- To what extent does collective efficacy affect the management of these curriculum changes which includes the effectiveness of teaching, learning and assessment strategies in mathematics, which mathematics teachers are implementing?

The effect of collective efficacy on the management of the curriculum changes is significant when considering the physical and human resource challenges these schools face. The analysis of the data and the research findings which are based on the responses of the mathematics teachers of the sample schools (refer to Appendix B2) showed that the mathematics teachers showed different teacher self-efficacy beliefs in terms of their control over the teaching, learning and assessment strategies in their respective schools as illustrated by Figure 4.5 and Figure 4.6. The responses of the mathematics teachers of the sample schools (refer to Appendix B) showed similar patterns of how all the teachers of the sample schools have scored the collective efficacy questionnaire (refer to Appendix A), which shows that collective efficacy of all the teachers affects the self-efficacy beliefs of the mathematics teachers in terms of the effective control, management and implementation of the curriculum changes.

- To what extent does mathematics efficacy affect mathematics teachers and learners in terms of effective teaching and learning methods, which leads to a better

conceptual understanding of mathematics, and consequently to better academic achievement by learners?

Based on the analysis of the interviews, the effect of mathematics efficacy is significant when considering the challenges around creating a culture of teaching and learning in these schools. The mathematics efficacy beliefs of the two grade eleven mathematics teachers per sample school were recorded on digital format and transcribed to text (refer to Appendix C3), and the analysis of the interviews according to the three themes (refer to Appendix C) have shown similarities of how all the mathematics teachers of the sample schools have felt about their self-efficacy beliefs (refer to Figure 4.5 and Figure 4.6) and their collective efficacy beliefs about their respective schools (refer to Figure 4.1).

Based on the analysis of the grade eleven mathematics test which was done by the grade twelve learners of the sample schools (refer to Appendix D4), the effect of mathematics efficacy shows significant patterns. These different responses of the mathematics learners in terms of how they have answered the different categories on the mathematics test (refer to Appendix D4) are illustrated in Figure 4.7, showing similarity with the analysis of the interviews, how all the mathematics teachers of the sample schools have felt about their teacher self-efficacy beliefs (refer to Figure 4.5 and Figure 4.6) and their collective efficacy beliefs about their respective schools (refer to Figure 4.1).

Based on the responses to the sub-ordinate questions of this study, the response to the primary research question can now be concluded. The primary research question reads as follows:

- To what extent does collective efficacy affect mathematics teachers implementing curriculum changes in mathematics, who teach in secondary schools situated in previously disadvantaged communities?

Collective efficacy affects mathematics teachers significantly when implementing curriculum changes, especially in schools situated in previously disadvantaged communities. By identifying certain patterns in both the quantitative and qualitative data of the sample schools, it is evident that the collective efficacy of the teachers of the sample schools affects perceptions and perspectives of all the teachers, that collective efficacy of all the teachers in the schools affect the teacher self-efficacy beliefs of the mathematics teachers in terms of implementing curriculum changes in mathematics, that collective efficacy of all the teachers in the schools affect mathematics efficacy of mathematics teachers about their expositions of mathematics in the schools where they teach, hence leading to a better conceptual understanding of mathematics and consequently to better academic achievements by learners.

Do the research findings support or falsify previous research developed by previous researchers on the topic?

Based on the answers to the sub-ordinate questions and the primary research question of this study, the research findings *support previous research* developed by Brinson and Steiner (2007:1) which states that *collective efficacy* is the perception of teachers in a school that the efforts of the institution as a whole will have a positive impact on student learning. Henson (2001:4) who defines teacher *self-efficacy* as a teacher's judgment of his/her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated, is also supported by the research findings of this study.

6.3 RECOMMENDATIONS

The recommendations of this study are solely based on the analysis of the data as presented in chapter four and the research findings presented in chapter five. The responses to the sub-ordinate and finally the primary question are also important considerations when the recommendations are made. The recommendations focus on two themes namely (a) the creation of teaching and learning cultures in schools and (b) effective teaching, learning and assessment practices for school mathematics.

These recommendations are made firstly to education authorities and school management teams to ensure that the conditions for effective teaching, learning and assessment strategies in all schools are in place, and secondly to education researchers and academics to develop academic literature which can kick-start the debate around the importance of effective teaching, learning and assessment cultures in all the schools. The

role of the mathematics teacher in a learner-centred environment, especially in poorly resourced schools, is also considered in the recommendations.

The limitations of the research which has a mixed method research design study is also outlined in terms of the sample, the limitation of the data collection strategies and the limitation of the analysis of the data. Further research on the topic is also suggested in order to enhance learner attainment in mathematics.

6.3.1 The creation of teaching and learning cultures in schools

It was shown in this study that collective efficacy beliefs of teachers in a particular school affect the perceptions and perspectives of teachers about their role in implementing the curriculum directives effectively, especially in mathematics. Education authorities have to ensure that strategic planning initiatives around curriculum implementation are communicated effectively to school governing bodies, principals, school management teams and teachers to ensure that proper long term, medium term and short term planning are undertaken in all the schools. These strategic plans developed by education authorities should mainly focus on how to bridge the gap between poor resources in schools and good academic achievement of learners. This could be achieved by putting proper curricular and co-curricular structures in place and empowering teachers through proper in-service training programmes to make sure that they deliver on proper teaching, learning and assessment strategies. Education authorities should also implement proper standardized practices and quality control measures for both the

management of schools and the effective implementation of the curriculum by both teachers and learners.

It is only when proper conditions for teaching, learning and assessment are created in schools that effective curriculum implementation can happen, even in schools which are faced with adverse socio-economic challenges. This study has shown that there is a relationship between how teachers perceive their respective schools to be and how those perceptions impact on the academic achievement of the learners. If teachers are positive about the manner in which their schools are managed, then those teachers are positive in the classrooms of those schools, and those positive engagements in the teaching, learning and assessment processes can override the adverse socio-economic status of schools. National and provincial departments of basic education should make sure, through proper planning and budgeting, that there is a qualified principal in every school and a qualified teacher in every classroom to ensure effective curriculum planning, curriculum management and effective curriculum delivery, especially in mathematics.

6.3.2 Effective teaching, learning and assessment practices for school mathematics

The teaching of mathematics in South African schools, especially those schools situated in previously disadvantaged communities, has been problematic for education authorities, subject specialists and mathematics teachers. Many reasons have been given by the subject analysts and academics as to why the under-performance of the

mathematics learners in those schools is still continuing. The common denominator, in all the deliberations by the stakeholders in mathematics education points to the role of the mathematics teacher improving results of mathematics learners, by creating a culture of effective teaching, learning and assessment practices, especially in mostly poorly resourced schools. A qualified mathematics teacher could be the most valuable resource to learners, who need quality mathematics education so badly, even when there is a severe shortage of resources such as adequate classroom space, textbooks, calculators, computers and other electronic equipment.

Mathematics teachers can only be effective in their classrooms if they firstly show compassion towards their learners, have sufficient subject knowledge and knowledge about the methods of mathematics teaching. This effectiveness by mathematics teachers is realized if they have positive perceptions and perspectives about the teaching, learning and assessment practices in the schools where they teach. It is therefore important that school governing bodies, principals and school management teams take the responsibility to ensure that a proper climate and proper structures for curriculum planning, curriculum management and curriculum implementation are in place. Once these structures are in place is it important for mathematics teachers to teach with passion and not with arrogance, to teach by example and not by hypocrisy and most of all, to encourage and challenge the strong learners while simultaneously to assist and motivate the weaker ones. It is only when teachers realize that their learners are human beings first before they are ‘vessels’ that need to be filled up with intellectual knowledge, and they teach them

self-discipline with love and empathy, that learners will truly appreciate the teaching skills and intellectual attributes of their teachers.

Researchers should therefore introduce academic literature and kick-start the debate about whether the role of the mathematics teacher should be a *teacher* or a *facilitator*, especially with the introduction of another curriculum, namely the Curriculum and Assessment Policy Statement (CAPS). With the introduction of outcomes-based education during the out-phased National Curriculum Statement (NCS), mathematics teachers still have different interpretations of their roles in the mathematics classroom in an education system which places the learner at the centre of the teaching, learning and assessment process. The role of mathematics teachers should therefore be clearly defined, their job description in terms of their roles in the teaching, learning and assessment process clearly outlined, and they should be trained to compose themselves as true professionals towards fellow teachers and learners, even under conditions that make their work very difficult. Academics in higher education institutions should link up with mathematics teachers and learners, especially those situated in previously disadvantaged communities, to develop their teaching and learning potential in mathematics and mathematics education through part-time courses and in-service training programmes.

6.3.3 Limitations of the research

The research design for this study applied both quantitative and qualitative research methods in selecting the sample and the design of the data collection instruments, data collection methods and data analysis. The research design for the

quantitative research method includes a survey, while the qualitative research method includes an ethnographic study. Both research designs present their unique limitations in terms of the research findings for this study.

- **Sample**

The sample for this study was 100 teachers ($n = 100$) which included both mathematics and non-mathematics teachers, and 100 grade twelve mathematics learners ($n = 100$) of the three sample schools. Purposive sampling was used in this study and is appropriate for an exploratory research design which uses a non-random sample to gain a deeper understanding about the questions which were probed on the two questionnaires (refer to Appendix A and Appendix B). The limitation of purposive sampling is that the researcher never knows whether the cases selected represent the population, and therefore limits its ability to make generalizations to a larger population.

- **Survey**

The questionnaires that were issued to the teachers in the sample schools had their own limitations, because the teachers were restricted to the questions on the questionnaire and the values allocated to the different responses. No provision was made on the questionnaires to probe certain responses from respondents in order to gain a better understanding as to why they select specific values on questionnaires.

The use of descriptive statistics in the analysis of the data in this study only describes the data, and is limited to make generalizations to a larger population, as no inferential statistics were used.

- **Ethnographic study**

The reason for adopting an exploratory research design was to address the weaknesses identified in the questionnaires by gaining an in-depth understanding of the ‘worlds’ of the teachers in the sample schools. Semi-structured interviews were used to explore some of the questions, which was not possible to do on the questionnaires, hence the teachers were given a chance to contextualize their responses. One of the weaknesses of interviews is the problem of bias, as the teachers responded through language which could be differently interpreted as opposed to the numerical values on the questionnaires, which characterize scientific and unbiased inquiry.

Despite the limitations outlined for both the quantitative and qualitative methods used in this study, the research findings could still be deemed valid and reliable. A mathematics test written by the mathematics learners and analyzed using descriptive statistics, was used to triangulate the responses of the teachers on the questionnaires and the responses of the teachers in the interviews. The reason for using the mathematics test was twofold, firstly to verify consistency of the responses of the teachers from the questionnaires and the interviews, and secondly whether those responses have influenced the attainment levels in the mathematics test differently. The research findings, despite

their limitations to generalize, could therefore support previous research on the topic, which forms the theoretical framework of this research.

6.3.4 Further research on the research topic

It is evident, through academic literature, newspaper articles and even court cases that poorly resourced schools are severely affected by poor infrastructure, which is coupled with the lack of physical and human resources. Further research is needed on how the education authorities could develop insightful ways to strengthen the capacity of poorly resourced schools that are faced with severe socio-economic challenges. Strengthening the capacity of these schools could change the perceptions and perspectives of the teachers, especially the mathematics teachers who could benefit their mathematics learners by implementing effective teaching, learning and assessment strategies.

This research has also shown that there is a relationship between curriculum planning, management and implementation processes and learner attainment in mathematics. Further research is needed around the capacity of researchers and strategic planners to design and develop strategic plans for school governing bodies, principals and middle managers regarding effective curriculum planning, curriculum management and curriculum implementation. These strategic plans could identify weaknesses in the curriculum chain and also provide solutions in order to maintain good curriculum practices in especially poorly resourced schools. Having good curriculum practices in

schools could enhance the capacity of teachers in these schools to execute their duties to the best of their abilities, irrespective of their socio-economic challenges.

Therefore the main focus of further research should be the creation of effective teaching, learning and assessment cultures in all public schools in South Africa. This type of research should not be copied from other countries and pasted onto the South African public schooling system, but should be proudly South African which could offer creative solutions to an education system which is riddled with massive socio-economic inequality, unequal language disparities and unacceptable low levels of learner attainment in the critical subjects, such as mathematics. This futuristic research could bring about acceptable levels of learner attainment in mathematics by South African learners, as measured against national and international benchmarking standards.

6.4 CONCLUSION

Specific conclusions for this study are drawn by reflecting firstly on the research objectives, and the main conclusion is subsequently drawn by reflecting on the research aim for this study. The manner in which the sub-ordinate questions was answered on the basis of the collection, analysis and interpretation of the data, and the research findings earlier in the chapter, reflects on the manner in which the research objectives were met. The main research aim manifests itself in the answer to the primary research question, which is the culmination of the responses to the three sub-ordinate questions.

General conclusions are drawn from the specific conclusions of this research and could be used as a basis to improve poorly resourced schools in obtaining the required learner attainment levels in mathematics. This is merely an alternative perspective presented by the research findings of this study, and not any generalizations.

6.4.1 Specific conclusions

The core mission of any school is learner attainment, irrespective of its socio-economic status. When schools are faced with adverse socio-economic conditions and also have teachers with negative self-perceptions about their institution, then the effective implementation of effective teaching, learning and assessment practices are severely compromised. But, when these poorly resourced schools have teachers with positive self-perceptions, then the implementation of effective teaching, learning and assessment practices becomes possible. Therefore effective curriculum management and curriculum implementation processes are prerequisites for good learner attainment.

This study has shown that, when the management structures in a school are committed to create conditions for effective teaching, learning and assessment practices, teachers will develop positive collective efficacy beliefs about their schools. With these positive collective efficacy beliefs teachers will influence the self-perception of mathematics teachers to be in control over the curriculum delivery process in the classrooms, and consequently let learners develop better concepts in mathematics, which lead to good academic results in mathematics.

The research has also shown that, when required from mathematics learners to engage with mathematics and mathematical thinking, the effect of collective efficacy of all their teachers, the teacher self-efficacy and mathematics efficacy of their mathematics teachers, and finally their own commitment and dedication towards mathematics are demonstrated. The effect of collective efficacy is finally realized when mathematics learners, especially those drawn from poorly resourced schools, show good problem solving skills and are well-prepared for the challenging and complex questions of mathematics posed in school-based assessment tasks and external examinations.

6.4.2 General Conclusions

The changes of the NCS curriculum to the CAPS curriculum, and the consequent introduction of new content in mathematics, pose new challenges once again for both teachers and learners in terms of teaching, learning and assessment strategies. This situation is further aggravated in poorly resourced schools that struggle with poor infrastructure, lack of textbooks, overcrowding, and poor monitoring and quality control measures by subject advisors. Added to this situation, are teachers who are unsure about conditions of employment, labour relation issues and democratic cultures in schools.

It is therefore important for both portfolio and standing committees on basic education in parliament to develop norms and standards for the public schooling system in South Africa. These norms and standards should outline the minimum policy requirements that public schools should have to operate as learning institutions. This policy intervention could assist with the lack of many human and physical resources that

poorly resourced schools are currently faced with. The effective implementation of such a policy in poorly resourced schools could change the negative self-perceptions that teachers in those schools might have.

It is only through the willing participation of all the stakeholders in education that all the schools will become centres of effective learning, conducive to sustaining all the curriculum practices and producing good quality learners in mathematics. The real test of the effect of collective efficacy on the introduction of curriculum changes in mathematics by teachers, and on mathematics teaching, learning and assessment processes as a whole is when schools have shown good levels of learner attainment.

REFERENCES

- Adams, W.E. (1997). Science laboratory environment in a South African college of education. *South African Journal of Education*, 17, 49-52.
- Adler, J. A. (2007). Empirical and theoretical reflections on researching mathematics for teaching in mathematics teacher education. *International Commission on Mathematics Instruction*. 24 October, 3-7.
- Adler, J A. & Reed, Y. (2003). *Challenges of teacher development: An investigation of take-up in South Africa*. Pretoria: Van Shaik Publishers.
- Aldous, A. (2004). Science and mathematics teachers' perceptions of C2005 in Mpumalanga Secondary schools. *African Journal of Research in SMT Education*, 8(1), 65-76.
- Aldridge, J.M., Fraser, B.J & Sebela, M.P. (2004). Using teacher action research to promote constructivist learning environments in South Africa. *South African Journal of Education*, 24, 245-253.
- Aldridge, J.M., Fraser, B.J. & Ntuli, S. (2009). Utilising learner environment assessment to improve teaching practices among in-service teachers undertaking a distance-education programme. *South African Journal of Education*, 29(2), 1-16.
- Aldridge, J.M., Laugksch, R.C. & Fraser, B.J. (2006). School-level environment and outcomes-based education in South Africa. *Learning Environments Research*, 9, 123-147.
- Aldridge, J.M., Laugksch, R.C., Seopa, M.A. & Fraser, B.J. (2005). Development and validation of an instrument to monitor the implementation of outcomes-based learning environments in science classrooms in South Africa. *International Journal of Science Education*, 9, 123-147.

- American Psychological Association (2001). *Publications Manual of the American Psychological Association, 5th Edition*. Washington, D.C.: American Psychological Association.
- Babbie, E. & Mouton, J. (2010). *The Practice of Social Research*. Oxford University Press.
- Babbie, E. (2004). *The Practice of Social Research, 10th Edition*. Belmont ,Chapman University: Wadsworth/Thompson Learning.
- Ball, D.L., Bass, H., Sleep, L. & Thames, M. (2005). *A theory of mathematical knowledge for teaching*. Paper presented at the Fifteenth ICMI Study: The Professional Education and Development of Teachers of Mathematics, State University of Sao Paulo at Rio Claro, Brazil, May, 15-20, 2005.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*, 191-174.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Bandura, A. (1993). Received self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*(2), 117-148.
- Bandura, A. (1997). *Self-efficacy in changing societies*. New York: Cambridge University Press.
- Bernstein, B. (2000). *Pedagogy, Symbolic Control and Identity: Theory, Research, Critique*. Revised Edition. Oxford, UK: Rowman & Littlefield Publishers.

- Brinson, D. & Steiner, L. (2007). Building Collective Efficacy, how Leaders Inspire Teachers to Achieve, *Issue Brief*. October 2007, 1-5.
- Brombacher, A. (2007). *Mathematical Literacy, A Reader*. Second Revised Edition, Cape Town: Bateleur Books.
- Bryman, A. & Cramer, D. (1990). *Quantitative Data Analysis for Social Scientists*. London: Routledge.
- Cakiroglu, E. (2000). *Pre-service elementary teachers' sense of reform orientated mathematics*. Unpublished doctoral dissertation. Indiana: Indiana University.
- Chisholm, L. (2003). *The Politics of Curriculum Review and Revision in South Africa*. Paper presented at the 'Oxford' International Conference on Education and Development, Oxford University, September, 9-11, 2003.
- Cohen, C., Manion, L. & Morrison, K. (2000). *Research Methods in Education*. New York: Routledge Falmer.
- Cohen, C., Manion, L. & Morrison, K. (2007). *Research Methods in Education*. New York: Routledge.
- Craven, M.L. (2002) *Mathematics teacher learning, communities of practice and the centrality of confidence*. Unpublished doctoral thesis. Johannesburg: University of the Witwatersrand.
- Creswell, J.W. (2003). *Research design: Qualitative, quantitative and mixed methods approaches (2nd ed)*. Thousand Oaks, CA: Sage.
- Creswell, J.W., Plano Clark, V.L., Gutman, M.L. & Hanson, W.E. (2003). Advanced mixed methods research designs. In Tahakkori, A. & Teddlie, C. (Eds), *Handbook*

of mixed methods in social and behavioral research, 209-240. Thousand Oaks, CA: Sage.

Creswell, J.W., Shope, S., Clark, V.L.P. & Green, D.O. (2006). How Interpretive Qualitative Research Extends Mixed Methods Research. *Research in the Schools* 13(1), 1-11.

Crick, R.D., McCombs, B., Haddon, A., Broadfoot, P. & Tew, M. (2007). The ecology of learning: factors contributing to learner-centred classroom cultures. *Research Papers in Education*, 22(3), 267-307.

Daily Dispatch (2007). *SA needs maths and science help*. October 29, p. 15.

Daily Dispatch (2011). *Department already using unqualified staff in critical subjects like maths and science*. October 6, p. 3.

Daily Dispatch (2011). *School funding change on cards for June*. April 29, p. 4.

DBE see Department of Basic Education.

Demerath, P. (2006). The science of context: Mode of response for qualitative researchers in education. *International Journal of Qualitative Studies in Education*, 19(1), 97-113.

Denzin, N.K. & Lincoln, Y. S. (2005). *The Sage Handbook of Qualitative Research*, 3rd Edition. Sage Publications.

Denzin, N.K. & Lincoln, Y.S. (2000). *Handbook of Qualitative Research*, 2nd Edition. Sage Publications.

Department of Basic Education, (DBE), (2010). *National Curriculum and Assessment Policy Statement (CAPS) for Mathematics, GR10-12, Final Draft*, Pretoria: Government Printers.

Department of Basic Education, (DBE), (2011). *Curriculum, Philosophy and Policies*. Pretoria: Government Printers.

DOE: see National Department of Education.

Durheim, K. (2002a). Research design. In Terre Blanche, M. & Durrheim, K (Eds). *Research in Practice. Applied methods for the social sciences*, 29-53. Cape Town: University of Cape Town Press.

Durheim, K. (2002b). Quantitative measurement. In Terre Blanche, M., & Durrheim, K (Eds). *Research in Practice. Applied methods for the social sciences*, 72-95. Cape Town: University of Cape Town Press.

Education Labour Relations Council (2003). *Policy Handbook for Educators*. Universal Print Group.

Fraenkel, J.R. & Wallen, N.E. (2006). *How to design and evaluate research in education*. London: Mc Grew Hill.

Friedel, J. M, Cortina, K. S, Turner, J.S & Midgley, C. (2007). Achievement goals, efficacy beliefs and coping strategies in mathematics: The roles of perceived parent and teacher goal emphasis. *Contemporary Education Psychology*, 32, 434-458.

Gall, M.D., Borg, W.R. & Gall, J.P. (1996). *Educational Research: An introduction*. White Plains, NY: Longman.

- Geist, J. & Hoy, W. K. (2004). Cultivating a culture of trust: Enabling school structure, teacher professionalism, and academic press. *Leading & Managing*, 10, 1- 7.
- Gill, M.C., Ashton.P. & Algina, J. (2004). Authoritative schools: A test of a model to resolve the school effectiveness debate. *Contemporary Educational Psychology*, 29, 389-409.
- Goddard, R. D., Hoy, W. K., & Woolfolk Hoy, A. (2004). Collective efficacy beliefs: Theoretical developments, empirical evidence, and future directions. *Educational Researcher*, 33(3), 3-13.
- Goddard, R. D., LoGerfo, L. & Hoy, W. K. (2004). High school accountability: the role of perceived collective efficacy. *Educational Policy*, 18(3), 403-435.
- Goddard, R.D. & Skrla, L. (2006). The influence of school social composition on teachers' collective efficacy beliefs. *Educational Administration Quarterly*, 42(2), 216-235.
- Goddard, R.D. (2002). A theoretical and empirical analysis of the measurement of collective efficacy: The development of a short form. *Educational and Psychological Measurement*, 93, 467-476.
- Goddard, R.D., Hoy, W.K., & Woolfolk Hoy, A. (2000). Collective teacher efficacy: It's meaning, measure, and effect on student achievement. *American Educational Research Journal*, 37(2), 479-507.
- Government Gazette (2011). Republic of South Africa, Pretoria, 555(34600), 1-8.
- Gravin, M. (2002). Coping with new mathematics teacher roles in a contradictory context of curriculum change. *The Mathematics Educator*, 12(2), 21-28.

- Grobler, G., Bisschop, T. & Beeka, A. (2012). Changing perceptions of teachers regarding the importance and competence of their principals as leaders. *South African Journal of Education*, 32(1), 40-55.
- Harley K. & Wedekind V. (2003). *Curriculum 2005 and outcomes-based education: What do we know about the real outcomes?* Article presented at the Annual Kenton Education Association Conference, Worcester, October 30 – November 3, 2003.
- Harley, K. & Wedekind, V. (2004). Political change, curriculum change and social transformation, 1990 to 2002. In Chisholm, L. (Ed) *Changing class: Education and social change in post-apartheid South Africa*, 195-220, Cape Town: HSRC.
- Hart, L.C., Smith, S.Z., Swars, S.L., & Smith, M.E. (2009). An Examination of Research Methods in Mathematics Education. *Journal of Mixed Methods Research*, 3(1), 26-41.
- Henson, R.K. (2001). *Teacher Self-Efficacy: Substantive Implications and Measurement Dilemmas*. Paper presented at the annual meeting of the Educational Research Exchange, Texas A & M University, Texas, January, 26, 2001.
- Hoang, T. N. (2008). The effects of grade level, gender, and ethnicity on attitude and learning environment in mathematics in high school. *International Electronic Journal of Mathematics*, 3 (1), 47-59.
- Hord, S.M. (2004). *Learning together: Leading together: Changing schools through professional learning communities*. New York: Teachers College Press.
- Hoy, A. W. (2003). An analysis of enabling and mindful school structures: Some theoretical, research and practical considerations. *Journal of Educational Administration*, 41(1), 87-108.

- Hoy, W. K. & Miskel, C. G. (2005). *Educational administration: Theory, research and practice* (7th ed). New York: McGraw-Hill.
- Hoy, W. K., Sweetland, S. R. & Smith, P. A. (2002). Toward an organizational model of achievement in high schools: The significance of collective efficacy. *Educational Administration Quarterly*, 38, 77 – 93.
- Hoy, W. K., Tarter, C.J. & Hoy, A. W. (2006). Academic optimism of schools: A force for student achievement. *American Educational Research Journal*, 43, 425-446.
- Huffman, D. & Kalnin, J. (2003). Collaborative inquiry to make data-based decisions in schools. *Teaching and Teacher Education*, 19, 569-580.
- Innabi, H. & El Sheikh O. (2006). The change in Mathematics Teachers' Perceptions of Critical Thinking after 15 years of Educational Reform in Jordan. *Educational Studies in Mathematics*, 64, 45-68. DOI: 10.1007/s10649-005-9017-x
- Jackson, L.T.D. & Rothmann, S. (2006). Occupational stress, organizational commitment, and ill-health educators in the North-West Province. *South African Journal of Education*, 26, 75-95.
- Jansen, J (2001). Rethinking Education Policy: Symbols of Change, Signals of Conflict. In Kraak, A. & Young, M. (Eds) *Educational Policy Implementation in South Africa*, 41-59, Pretoria: HSRC.
- Jansen, J.& Christie P. (1999). *Changing Curriculum Studies on Outcomes-based Education in South Africa*. Juta.
- Jerald, C. D. (2007). *Believing and achieving*. Washington, D.C.: Center for Comprehensive School Reform and Improvement.

- Johnson, R.B. & Onwuegbuzie, A. J. (2004). Mixed Method Research: A Research Paradigm Whose Time Has Come. *Educational Researcher* 33(7), 14-26.
- Johnson, R.B., Onwuegbuzie, A.J. & Turner, L.A. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research*, 1(2), 112-133.
- Kahn, M. (2004). For whom the school bell tolls: disparities in performance in senior certificate mathematics and physical science, *Perspectives in Education*, 22(1), 149-156.
- Killen, R. (2000). *Teaching Strategies for Outcomes-based Education*. Lansdowne: Juta & Co. Ltd.
- Kotze, T. (2007). *Guidelines on writing a first quantitative academic article, 2nd Edition*. Pretoria: University of Pretoria.
- Leedy, P. D., & Ormod, J. E. (2005). *Practical research: planning and design*. Eight Edition. Upper Saddle River, New Jersey: Merrill Prentice Hall.
- Lincoln, Y.S. & Cannella, G.S. (2004). Dangerous discourses: Methodological conservation and governmental regimes of truth. *Qualitative Inquiry*, 10, 5-14.
- Lunenburg, F. C., & Irby, B. J. (2006). *The principalship: Vision to action*. Belmont, CA: Thomson Wadsworth.
- Malloy, C. (2002). Democratic access to mathematics through democratic education: An introduction. In English, L. (Ed.). *A handbook of international research in mathematics education*, 17-26. Mahwah, NJ: Lawrence Erlbaum Associates.

- Maree, J. G. & Louw, C. J. (2007). The nature, purpose and effectiveness of assessment in tertiary mathematics at Tswane University of Technology. *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie, Jaargang 26 No 4: Desember 2007.*
- Maree, J.G. & Erasmus, C.P. (2006). Mathematics skills of Tswana-speaking learners in the North West Province of South Africa. *Early Child Development and Care, 176 (1)*, 1-18.
- Mawhinney, H. B., Haas, J. & Wood, W. (2005). Teacher's Perceptions of Collective Efficacy and School Conditions for Professional Learning. Paper Presented to the Annual Meeting of the University Council for Educational Administration. *Democracy in Educational Leadership: The Unfinished Journey Toward Justice.* Nashville, TN, November, 1, 2005.
- McGuigan, L. (2005). *The role of enabling bureaucracy and academic optimism in academic achievement growth.* Unpublished PhD Dissertation. Ohio: Ohio State University.
- Middleton, M. J., Kaplan, A & Midgley, C (2004). The change in middle school students' achievement goals in mathematics over time. *Social Psychology of Education, 7*, 289-311.
- Moghaddam, F.M., Walker, B.R., & Harre, R. (2003). Cultural Distance, levels of abstraction and the advantages of mixed methods. In Tashakkori, A. & Teddlie, C. (Eds.), *Handbook of mixed methods in social & behavioral research*, 111-134. Thousand Oaks, CA: Sage.
- Moodaley, R., Grobler, A. & Lens W. (2006). Study orientation and causal attribution in mathematics achievement. *South African Journal of Psychology, 36 (3)*, 634-655.

- Morrow, W. (2002). *Research in Education*. Port Elizabeth: Nelson Mandela Metropolitan University.
- Morse, J.M. (2003). Principles of mixed methods and multimethod research design. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioural research*, 189-208. Thousand Oaks, CA: Sage.
- Motshekga, A. (2009). Address by the Minister of Basic Education, Ms Angie Motshekga at the Quality Learning and Teaching Campaign business breakfast, Sandton Convention Centre, 01 October 2009. Retrieved 16 October, 2009 from <http://www.education.gov.za>
- Motshekga, A. (2010). *Curriculum News: Improving The Quality Of Learning And Teaching*. A Message from the Minister of Basic Education, Improving Curriculum Implementation: Update. May, 2010. Pretoria: Government Printers.
- Motshekga, A. (2011a). *Curriculum News. Improving the quality of learning and teaching*. Strengthening Curriculum Implementation from 2010 and beyond. May 2011. Pretoria: Government Printers.
- Motshekga, A. (2011b). Statement on the release of the Annual Assessment Results for 2011 by Ms Angie Motshega, Minister of Basic Education, Union Buildings. Report released on 28 June, 2011. Retrieved 4 August, 2011 from <http://www.education.gov.za>
- Mouton, J. (2004). *How to succeed in your Master's and Doctoral Studies. A South African Guide and Resource Book*. Pretoria: Van Shaik Publishers.
- Naidoo, D. & Parker, D (2005). The implications of mathematics teachers' identities and official discourse for democratic access to mathematics, *Perspectives in Education*, 23(1), 53-67.

National Council of Teachers of Mathematics Research Advisory Committee (2003). Education research in the No Child Behind environment. *Journal for Research in Mathematics Education*, 34(3), 185-189.

National Department of Education (DOE), (2000). *A South African Curriculum for the Twenty-First Century: Report on the Review Committee on Curriculum 2005*. Pretoria: Government Printers.

National Department of Education (DOE), (2002). *Revised Curriculum Statement Grades R-9 (Schools, Policy)*, Pretoria: Government Printers.

National Department of Education (DOE), (2003a). *National Curriculum Statements 10-12 (General). Mathematics* Pretoria: Government Printers.

National Department of Education (DOE), (2003b). *Revised Curriculum Statement Grades R-9 (Schools)*. Pretoria: Government Printers.

National Department of Education (DOE), (2004). *National Curriculum Statements 10-12 (General). Mathematics* Pretoria: Government Printers.

National Department of Education (DOE), (2005). Subject Assessment Guidelines Mathematics, *National Curriculum Statement, Grades 10-12 (General)*. Pretoria: Government Printers.

National Department of Education (DOE), (2006). *National Examiner's Report for Gr.12 Mathematics*. Pretoria: Government Printers.

National Department of Education (DOE), (2007a). *Western Cape Education: MEC'S Announcement of 2007 Matric Results*. [Online]. Available: [http://www.education.gov.za / ref. html](http://www.education.gov.za/ref.html) [21 May 2008].

National Department of Education (DOE), (2007b). Subject Assessment Guidelines Mathematics, *National Curriculum Statement, Grades 10-12 (General)*. Pretoria: Government Printers.

National Department of Education (DOE), (2008). Subject Assessment Guidelines Mathematics, *National Curriculum Statement, Grades 10-12 (General)*. Pretoria: Government Printers.

Neuman, W. L. (2006). *Social Research Methods. Qualitative and Quantitative Approaches (6th Ed)*. University of Wisconsin.

Neyland, J. (2004). Toward a postmodern ethics of modern education. In M. Walshaw (Ed), *Mathematics education within the postmodern*, 55-73. Greenwich, Ct: Information Age Publishing.

Nicolaidou, M. & Philippou, G. (2003). Attitudes Towards Mathematics, Self- Efficacy and Achievement in Problem-Solving. *European Research in Mathematics Education*, 3, 1-11.

Pajares, F. (2002). *Overview of social theory and of self-efficacy*. Retrieved July, 08, 2004, <http://www.emory.edu/EDUCATION/mpf/eff.html>

Parker, D. & Adler, J. (2005). Constraint or Catalyst? The regulation of teacher education in South Africa *Journal of Education*, 36, 59-78.

Parker, D. (2006). Grade 10-12 Mathematics curriculum reform in South Africa: A textual analysis of new national curriculum statements. *African Journal of Research in SMT Education*, 10(2), 59-73.

Patton, M.Q. (2001). *Qualitative Research & Evaluation Methods, 3rd Edition*. Sage Publications.

- Perry, C. Carson, D. & Gilmore, A. (2003). Joining a conversation: Writing for EJM's editors, reviewers and readers requires planning, care and persistence. *European Journal of Marketing*, 37(5/6), 652-557.
- Pintrinch, P. & Schunk, D.H. (2002). *Motivation in Education: Theory research, and applications* (2nd edition). Upper Saddle River: Pearson Education.
- Puchner, D. P, & Taylor A. R (2006). Lesson study, collaboration and teacher efficacy: Stories from two school-based math lesson study groups. *Teacher and Teacher Education* (22), 922-934.
- Reddy, V. (2004). *Performance scores in international math and science study reflective of South African Inequalities*. (TIMSS Media Release), Pretoria: Human Sciences Research Council.
- Roberts, L. & Roach, J. (2006). *Leadership Styles and Practice in Effective Schools*, Research Series. Johannesburg: Gauteng Department of Education.
- Rogan, J.M. (2004). Out of the frying pan...?: Case studies of the implantation of Curriculum 2005 in some science classrooms. *African Journal of Research in SMT Education*, 8(2), 165-179.
- Rose, J.S. & Medway, F.J. (1981). Measurements of teachers' beliefs in their control over students' outcome. *Journal of Educational Research*, 74, 185-190.
- Ross, J. A., & Gray, P. (2006) Transformational leadership and teacher commitment to organizational values: The mediating effects of collective teacher efficacy. *School Effectiveness and School Improvement*, 17(2), 179-199.

- Rotter, J. B. (1966). Some problems and misconceptions related to the construct of internal versus external control of reinforcement. *Journal of Consulting and Clinical Psychology Report*, 63, 407-414.
- Rubin, A. & Babbie, E. (2001). In: De Vos, A.S., Strydom, H., Fouché, C. B. & Delpont, C. S. L. (2007). *Research at Grassroots for the Social Sciences and Human Service Professions*. Pretoria: Van Schaik Publishers.
- Schoenfeld, A.H. (2007). Method. In F.K. Lester Jr (Ed), *Second Handbook of research on mathematics teaching and learning*, 69-107. Charlotte, NC: Information Age, for the National Council of Teacher of Mathematics.
- Sebela, M.P. (2009). Using Teacher Action Research to Promote Constructivist Classroom Learning Environments in Mathematics in South Africa. Retrieved on 26 March, 2009 from <http://www.aare.edu.au/01pap/seb01443.htm>
- Silver, E. (2004). Ella Minnow Pea: An allergy of our times? *Journal for Research in Mathematics Education*, 35(3), 154-156.
- Skovsmose, O. & Valero, P. (2002) Democratic access to powerful mathematical ideas. In L. English (Ed.), *A handbook of international research in mathematics education* (383-408). Mahwah, NJ: Lawrence Erlbaum Associates.
- Solomon, C. B. (2007). *The relationship among middle level leadership, teacher commitment, teacher collective efficacy, and student achievement*. Unpublished PhD Dissertation. Columbia: University of Missouri-Columbia.
- Statistics South Africa (2001). Census. Government Information System (GIS), Pretoria: Government Printers.

- Steen, L.A. (2001). The case for quantitative literacy. In National Council on Education and the Disciplines. In Steen, L.A. (Ed), *Mathematical and Democracy*, 1-22. Washington: The Mathematics Association of America.
- Stipek, D. J. (2002). *Motivation to learn: Integrating theory and practice*. Boston: Allyn & Bacon.
- Swars, S.L. (2005). Examining Perceptions of Mathematics Teaching Effectiveness among Elementary Preservice Teachers with Differing Levels of Mathematics Teacher Efficacy. *Journal of Instructional Psychology*, 32(2), 139-147.
- Tashakkori, A. & Teddlie, C. (Eds). (2003). *Handbook of mixed methods in social and behavioral research*, Thousand Oaks, CA: Sage.
- Taylor, P.C. & Fraser B.J. (1991). Development of an instrument for assessing constructivist learning environments. *Paper presented at the annual meeting of the American Educational Research*, 27(4), 293-302.
- Taylor, P.C., Dawson, V. & Fraser, B.J. (1995). Classroom learning environments under transformation: A constructivist perspective. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, April, 22-25, 1995.
- Taylor, P.C., Fraser, B.J. & Fisher, D.L. (1997). Monitoring constructivist learning environments. *International Journal of Science*, 459, 414-419.
- Terre Blanche, M. & Durrheim, K. (2002). *Research in Practice. Applied methods for the social sciences*. Cape Town: University of Cape Town Press.

- Terre Blanche, M. & Kelly, K. (2002). Interpretive Methods in Terre Blanche, M., & Durrheim, K (Eds). *Research in Practice. Applied methods for the social sciences*, 123-146. Cape Town: University of Cape Town Press.
- Thomas, D. & Brown, J.S. (2009). *Learning for a world of constant change: Homo sapiens, homo faber & homo Ludens revisited.* . Retrieved on 6 July, 2011 from <http://www.johnseelybrown.com/Learning%20for%20%20World%20of%20Constant%20Change.pdf>
- TIMSS, (2003). Country by Country Profiles of Achievements in the Mathematics Cognitive Domains. TIMSS & PIRLS International Study Center: Lynch School of Education, Boston College.
- Tredoux, C. (2002). Sound conclusions: judging research designs. In Terre Blanche, M., & Durrheim, K (Eds). *Research in Practice. Applied methods for the social sciences*, 309-330. Cape Town: University of Cape Town Press.
- UNICEF, (2003). *The state of the world's children 2004*. New York: The United Nations Children's Fund.
- Van der Walt, M.S. & Maree, J.G (2007). Do mathematics learning facilitators implement metacognitive strategies? *South African Journal of Education* 27(2), 223-241.
- Van der Walt, M.S., Maree, J.G. & Ellis, S.M. (2008). Metacognition in the Learning of Mathematics in the Senior Phase: Some Implications for the Curriculum. *International Journal of Adolescence and Youth*, 14, 205-235.
- Van der Westhuizen, P.C., Mosoge, M.J., Swanepoel, L.H. & Coetzee, L.D. (2005). Organizational culture and academic achievement in secondary schools. *Education and Urban Society*, 38, 89-105.

- Vithal, R. & Gopal, N. (2005). What learners say about the new South African curriculum reform. *Perspectives in Education*, 23, 45-59.
- Vithal, R., Adler J. & Keitel C. (2005). *Researching mathematics in South Africa: Perspectives, practices and possibilities*. Pretoria: Human Sciences Research Council.
- Vos, D., Van der Westhuizen, P.C., Mentz, P.J. & Ellis (2012). Educators and the quality of their work environment: an analysis of the organizational climate in primary schools. *South African Journal of Education*, 32(1), 56-68.
- Walls, F. (2004). *Using rights-based frameworks for rethinking teacher-directed pedagogies of mathematics*. Retrieved on 24 October, 2007 from Fiona.walls@jcu.edu.au
- Webb, P. & Glover, H. (2004). *Perspectives in Science and Mathematics Education*. Port Elizabeth: Bay Books.
- Wenta, R.G. (2000). *Efficacy of preservice elementary mathematics teachers*. Unpublished doctoral dissertation. Indiana: Indiana University.
- Wisker, G. (2001). *The Postgraduate Research Handbook*. Wales: Creative, Print and Design (Ebbw vale).
- Woolfolk Hoy, A. (2004). *What Preservice Teachers Should Know about Recent Theory and Research in Motivation*. Paper presented at the annual meeting of the American Research Association, San Diego, C.A, April, 15, 2004.
- Wrigley, T. (2003) *Schools of Hope: a new agenda for school improvement*. London: Trentham Books.

APPENDICES

APPENDIX A: COLLECTIVE EFFICACY QUESTIONNAIRE

Solomon (2007:50) provides a more extensive definition of collective efficacy as the collective self-perception that teachers in a particular school have to make an educational difference to their learners over and above that of their homes and communities.

The purpose of this questionnaire is to assess whether collective efficacy in your school affects the perceptions and perspectives of all the teachers on the staff, both mathematics and non-mathematics teachers, that the changes in the new curriculum could be implemented effectively.

NAME OF SCHOOL: SCHOOL A, SCHOOL B OR SCHOOL C

NAME OF TEACHER: Please enter DAY, MONTH, YEAR of birth followed by INITIALS.

EXAMPLE: 15021965WWH NAME OF TEACHER:

.....

MALE

FEMALE

Instructions:

1. Please score the statements by putting a **circle** around the appropriate response.
2. Only **one circle** per statement is allowed.

Responses:

1 = *strongly disagree*

3 = *neither disagree nor agree*

4 = *agree*

2 = *disagree*

5 = *strongly agree*

CATEGORY 1: THE EFFECTIVENESS OF THE SCHOOL

- 1.1 The school is effective in maintaining good academic standards, and therefore encourages positive attitudes towards teaching and learning. **1 2 3 4 5**

- 1.2 A sense of identity and pride exist in the school, which lead to teachers being clear about the academic mission of the school. **1 2 3 4 5**
- 1.3 The school is guided by effective instructional techniques, hence teachers show high morale in teaching, learning and assessment practices. **1 2 3 4 5**
- 1.4 The school is adequately resourced in a manner that fosters confidence amongst teachers and learners in both curricular and co-curricular activities. **1 2 3 4 5**
- 1.5 The school shows strong leadership in developing structures and processes for teachers to use for curriculum planning and curriculum delivery. **1 2 3 4 5**

CATEGORY 2: THE ATTITUDE OF THE LEARNERS

- 2.1 The learners of the school are generally well-behaved, and there is therefore a culture of teaching and learning created within the school. **1 2 3 4 5**
- 2.2 The learners accept authority from their teachers, hence making effective teaching, learning and assessment practices easier. **1 2 3 4 5**
- 2.3 Social interaction is encouraged amongst learners to develop good relations, especially when group work amongst learners is used as a teaching strategy. **1 2 3 4 5**
- 2.4 Learners are made active participants in the learning process and as a result, stimulate their own critical and independent thinking, especially when solving high order problems. **1 2 3 4 5**
- 2.5 Learners are made aware that they are responsible for their own progress, hence curriculum planning and curriculum delivery is manageable. **1 2 3 4 5**

CATEGORY 3: CLASSROOM PRACTICE

- 3.1 Positive control practices created by the school enforce effective teaching, learning and assessment processes in the classroom. **1 2 3 4 5**
- 3.2 Learners are made aware of the challenges of an outcomes-based approach to teaching, learning and assessment, hence creating awareness of the challenges in the new curriculum. **1 2 3 4 5**
- 3.3 Academic demanding classrooms in the school lead to both teacher appraisal and learner encouragement, which contribute to a high moral of work ethic. **1 2 3 4 5**
- 3.4 Effective teaching practices in the school enables teachers to exhibit the best practices of teaching and learners are motivated by good teachers' expositions and clear explanations. **1 2 3 4 5**
- 3.5 Effective teaching practices in the school encourage teachers to complete the work schedule in time and learners are expected to write tests and examinations of good quality. **1 2 3 4 5**

CATEGORY4: TEACHING, LEARNING AND ASSESMENT STRATEGIES

- 4.1 An understanding by teachers about outcomes-based education (OBE), contributes to better teaching, learning and assessment practices by both teachers and learners. **1 2 3 4 5**
- 4.2 The use of new technologies e.g. internet, online libraries, inter-active whiteboards etc. as part of teaching and learning strategies in the school, contributes to better research by both teachers and learners. **1 2 3 4 5**

CATEGORY 5: PROFESIONAL DEVELOPMENT AND SUPPORT

- 5.1 The constant evaluation of good teaching and learning practices by senior management (SMT) foster good morale and high work ethics amongst the teachers and learners. **1 2 3 4 5**
- 5.2 The constant monitoring of good teaching and learning practices by senior management (SMT) leads to better curriculum planning and curriculum delivery. **1 2 3 4 5**
- 5.3 Opportunities for in-service training in areas where teachers need support make them aware of the challenges in the new curriculum. **1 2 3 4 5**

CATEGORY 6: LEADERSHIP AND MANAGEMENT

- 6.1 The leadership of the school portrays professional competence and commitment, hence setting an example for good classroom practice amongst teachers and learners. **1 2 3 4 5**
- 6.2 The leadership of the school portrays a positive relationship between the senior management team (SMT) and the staff, which consequently leads to positive engagement in both the teaching and the learning processes. **1 2 3 4 5**
- 6.3 The management of resources is in proportion to the school's development planning, and caters adequately for the teaching and learning needs of both teachers and learners. **1 2 3 4 5**
- 6.4 The procedures for communicating with teachers, learners and parents are in place, which is used as a platform to discuss important curriculum issues. **1 2 3 4 5**

- 6.5 Support structures (counseling services, pastoral care etc.) are in place to assist teachers and learners in need, especially those who cannot cope with the demands of the new curriculum. **1 2 3 4 5**
-

Questionnaire adapted from survey guidelines used at the Research Institute for Public Policy and Management, Keele University, England.

APPENDIX A1: COLLECTIVE EFFICACY SPREADSHEETS

COLLECTIVE EFFICACY SPREADSHEET (APPENDIX A1)																									
NAME OF SCHOOL: SCHOOL A																									
	STATEMENTS																								
	CATEGORY 1 THE EFFECTIVENESS OF THE SCHOOL					CATEGORY 2 THE ATTITUDE OF THE LEARNERS					CATEGORY 3 CLASSROOM PRACTICE					CATEGORY 4 TEACHING, LEARNING AND ASSESSMENT			CATEGORY 5 PROFESSIONAL DEVELOPMENT AND SUPPORT			CATEGORY 6 LEADERSHIP AND MANAGEMENT			
TEACHERS' RESPONSES	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	3.4	3.5	4.1	4.2	5.1	5.2	5.3	6.1	6.2	6.3	6.4	6.5
1	5	4	4	4	4	2	2	4	1	4	4	4	4	5	4	2	4	4	4	4	4	4	4	4	2
2	4	4	4	2	3	2	2	4	4	4	4	2	4	4	3	2	4	3	3	4	4	4	3	4	1
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4	5	4	4	4	4	2	2	3	2	4	4	5	4	5	5	4	5	4	4	4	4	4	4	5	5
5	2	2	2	1	2	2	2	4	3	4	2	4	2	2	2	4	2	2	4	4	2	2	2	3	2
6	4	4	4	2	4	2	2	4	4	3	2	3	2	3	2	4	4	3	3	4	3	3	2	4	2
7	2	3	3	2	3	2	3	4	4	4	3	4	4	4	4	4	4	4	4	4	4	3	4	4	3
8	3	2	3	3	3	2	3	3	3	3	3	4	2	3	3	3	2	3	3	3	1	2	2	3	2
9	4	4	4	4	3	3	3	3	4	4	4	4	4	4	4	3	4	4	4	3	4	4	4	3	3
10	2	2	2	2	2	1	1	4	3	3	2	4	2	3	4	2	1	2	3	4	2	2	3	2	1
11	3	3	3	2	2	1	3	3	2	1	3	3	3	4	4	4	2	3	3	4	2	3	3	4	2
12	2	2	2	1	2	1	2	3	3	3	2	3	2	3	3	2	2	3	3	3	2	2	1	3	1
13	3	3	2	2	2	3	4	4	3	4	3	4	2	4	4	4	2	3	3	2	4	3	1	4	1
14	2	1	3	3	1	2	3	4	4	4	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
15	1	1	1	1	1	1	2	2	1	2	1	3	2	3	3	4	4	4	4	4	4	4	4	3	2
16	4	4	2	2	1	1	1	2	3	2	4	4	1	1	4	4	1	4	4	1	1	1	1	3	1
17	5	5	4	4	4	1	2	3	2	1	4	4	2	4	4	5	5	4	4	4	2	3	3	4	4
18	3	3	2	2	3	2	3	3	2	4	3	4	3	4	4	3	2	3	4	2	4	4	3	4	3
19	2	1	2	1	1	2	2	4	4	2	1	2	2	3	4	4	1	2	2	1	1	1	2	2	1
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21	2	2	3	2	3	1	1	3	3	1	2	3	1	3	3	3	2	1	1	4	2	1	1	2	3
22	1	3	2	3	2	3	3	4	2	3	4	4	3	4	3	2	2	2	2	3	3	4	3	3	2
23	4	3	3	2	4	3	3	4	4	3	4	3	2	3	4	3	2	4	4	2	4	3	4	4	3
24	2	2	2	3	3	3	2	3	3	3	3	4	3	3	4	4	3	2	3	4	4	3	3	3	2
25	4	4	4	4	4	3	4	4	4	4	4	4	5	3	3	4	4	4	4	3	4	4	3	4	4
26	3	3	3	2	2	2	2	3	1	2	3	2	4	3	2	4	3	2	4	3	4	2	3	2	1
27	1	2	3	2	3	3	3	4	1	3	4	2	2	4	2	3	2	2	3	4	4	4	3	3	2
28	4	4	3	4	3	3	2	4	3	2	3	3	2	3	3	3	4	4	3	2	3	4	3	2	2
29	4	4	4	4	4	3	3	4	4	3	3	3	3	4	4	3	3	4	4	3	3	3	3	2	2
30	3	4	3	2	3	1	2	3	3	3	4	4	3	4	3	2	2	2	2	3	4	4	3	2	1
31	2	2	3	4	3	2	2	2	2	2	3	4	4	3	4	2	1	3	3	3	3	3	3	2	2
32	4	3	2	3	4	3	3	2	2	3	4	4	4	3	3	2	2	4	4	4	4	4	4	3	2

Responses:

1 = *strongly disagree*

3 = *neither disagree nor agree*

4 = *agree*

2 = *disagree*

5 = *strongly agree*

COLLECTIVE EFFICACY SPREADSHEET (APPENDIX A1)

NAME OF SCHOOL: SCHOOL B

	STATEMENTS																									
	CATEGORY 1 THE EFFECTIVENESS OF THE SCHOOL					CATEGORY 2 THE ATTITUDE OF THE LEARNERS					CATEGORY 3 CLASSROOM PRACTICE					CATEGORY 4 TEACHING, LEARNING AND ASSESSMENT		CATEGORY 5 PROFESSIONAL DEVELOPMENT AND SUPPORT			CATEGORY 6 LEADERSHIP AND MANAGEMENT					
TEACHERS' RESPONSES	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	3.4	3.5	4.1	4.2	5.1	5.2	5.3	6.1	6.2	6.3	6.4	6.5	
1	2	2	2	1	2	2	2	3	3	4	2	3	2	2	3	2	1	2	3	3	2	3	2	2	1	
2	3	4	3	1	1	1	1	4	4	2	1	3	2	4	4	4	1	1	1	1	3	1	1	1	1	
3	3	2	2	2	1	1	1	2	3	3	2	2	2	3	3	4	3	3	3	3	2	2	2	2	2	
4	3	3	2	2	2	3	4	4	3	3	3	3	4	3	4	3	4	3	3	3	3	3	2	3	2	
5	4	3	2	2	4	2	2	4	4	4	4	3	3	4	3	4	5	4	4	5	2	2	2	2	2	
6	2	2	3	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	
7	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
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14	4	3	4	4	3	2	2	3	4	3	4	4	3	3	4	2	2	4	4	4	3	3	3	2	2	
15	4	4	4	4	4	2	2	3	3	2	3	3	3	3	2	4	3	4	4	4	4	4	4	4	4	
16	2	1	1	2	1	2	2	2	3	3	2	4	2	2	2	1	1	2	2	1	1	1	1	2	1	
17	3	3	4	1	4	1	4	4	4	4	5	4	4	4	4	4	1	3	3	3	3	3	2	4	3	
18	2	2	2	2	2	1	2	4	2	2	2	2	2	2	4	2	2	4	4	2	2	2	2	3	3	
19	2	1	1	1	1	1	1	2	3	3	2	3	1	3	4	3	3	1	1	3	1	1	1	1	1	
20	3	3	3	2	3	1	1	2	1	2	2	2	3	3	3	3	1	2	2	2	1	2	1	1	1	
21	3	3	3	2	1	1	2	4	4	5	2	4	2	3	2	4	4	4	4	4	2	2	2	1	1	
22	3	4	3	2	1	2	2	4	4	3	2	1	4	4	4	4	4	4	4	4	2	2	2	1	1	
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25	2	2	1	1	1	2	1	2	1	2	2	2	1	1	1	1	1	1	2	1	2	2	1	1	1	
26	3	2	2	3	1	2	2	2	1	2	1	1	2	1	2	2	1	2	1	1	1	2	1	1	1	
27	2	1	2	3	2	2	2	1	2	1	3	2	3	3	2	2	1	2	1	1	2	1	2	3	1	
28	2	1	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	2	2	3	2	2	2	1	
29	1	1	1	1	1	2	1	3	4	4	1	2	1	2	2	2	2	2	1	2	3	3	2	2	2	
30	2	1	1	2	1	1	2	2	1	2	1	2	1	3	2	3	3	1	2	2	2	2	1	2	1	
31	2	2	1	2	1	2	2	1	2	1	2	3	2	3	2	2	1	3	2	1	2	2	2	1	3	2
32	3	3	2	3	2	2	2	3	2	2	3	3	3	2	3	3	2	3	3	3	3	3	2	3	3	
33	4	4	3	3	3	3	3	2	3	2	2	2	3	4	4	3	3	4	4	3	3	3	3	2	2	
34	3	4	3	2	2	2	4	4	3	2	3	3	3	3	3	4	3	2	2	3	3	3	3	1	2	
35	3	3	4	3	3	2	3	3	2	3	3	2	2	3	3	2	2	2	2	3	2	2	3	1	1	
36	2	3	1	3	2	1	1	3	2	2	2	2	3	2	3	2	2	3	3	3	2	2	2	2	2	

Responses:

1 = strongly disagree

3 = neither disagree nor agree

4 = agree

2 = disagree

5 = strongly agree

COLLECTIVE EFFICACY SPREADSHEET (APPENDIX A1)

NAME OF SCHOOL: SCHOOL C

	STATEMENTS																								
	CATEGORY 1 THE EFFECTIVENESS OF THE SCHOOL					CATEGORY 2 THE ATTITUDE OF THE LEARNERS					CATEGORY 3 CLASSROOM PRACTICE					CATEGORY 4 TEACHING, LEARNING AND ASSESSMENT		CATEGORY 5 PROFESSIONAL DEVELOPMENT AND SUPPORT			CATEGORY 6 LEADERSHIP AND MANAGEMENT				
TEACHERS' RESONSES	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	3.4	3.5	4.1	4.2	5.1	5.2	5.3	6.1	6.2	6.3	6.4	6.5
1	4	4	3	2	3	4	3	4	4	5	4	3	3	5	4	5	5	5	5	5	3	3	2	1	1
2	5	5	5	3	5	3	3	4	5	5	5	5	4	5	4	4	3	4	4	5	4	4	4	5	2
3	1	3	1	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
4	3	3	4	3	4	2	2	2	2	2	3	2	3	2	3	2	2	2	3	3	3	3	3	3	3
5	4	3	4	4	4	3	4	4	3	3	4	3	3	4	4	3	5	4	4	3	3	3	3	3	3
6	3	3	3	2	3	3	3	3	2	3	2	3	2	2	3	3	2	3	3	3	3	3	3	3	2
7	4	4	2	4	4	1	1	4	3	4	4	4	3	3	4	3	4	4	4	4	3	3	4	4	1
8	4	4	4	2	4	3	3	4	2	4	4	4	4	4	4	4	3	4	4	3	4	4	4	3	3
9	4	4	4	4	4	4	3	4	3	4	4	3	3	4	4	3	3	3	4	4	4	4	4	4	4
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12	4	3	2	2	2	3	3	4	3	3	3	3	2	4	3	4	2	3	2	2	2	2	2	3	3
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14	5	4	4	4	5	4	5	5	4	5	3	4	4	3	3	4	4	4	5	4	4	5	5	4	3
15	3	4	3	2	5	1	2	4	5	5	5	5	5	5	5	3	4	3	5	3	5	4	3	5	4
16	3	3	2	2	2	2	2	3	2	2	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2
17	3	3	3	4	2	3	3	4	3	4	3	4	4	3	4	4	4	3	3	2	3	1	2	2	3
18	5	5	5	5	5	3	3	4	4	4	4	5	4	5	5	5	5	4	4	4	4	4	4	5	5
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26	3	3	3	2	4	4	4	2	2	4	3	2	3	4	4	3	5	4	4	3	4	4	4	4	4
27	3	4	5	4	3	2	4	4	3	3	4	3	4	4	4	2	4	2	1	1	1	1	2	1	2
28	4	3	3	2	4	4	4	4	2	4	4	4	4	4	4	2	5	4	4	3	4	4	4	4	4
29	4	5	5	3	5	5	4	4	4	5	5	4	4	4	5	3	5	4	4	3	4	4	3	4	3
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31	4	4	3	3	4	4	3	3	3	4	4	4	4	4	3	4	3	4	4	3	4	4	3	4	3
32	3	3	4	4	4	3	4	3	4	3	3	3	4	4	4	3	3	4	3	3	4	3	4	3	2

Responses:

1 = strongly disagree

3 = neither disagree nor agree

4 = agree

2 = disagree

5 = strongly agree

APPENDIX B: MATHEMATICS TEACHERS' SELF-EFFICACY QUESTIONNAIRE

Henson (2001:4) defines teacher self-efficacy as a teacher's judgment of his/her capabilities to bring about desired outcomes of learner engagement and learning, even among those learners who may be difficult or unmotivated.

The purpose of this questionnaire is to assess the judgments of mathematics teachers in terms of the effectiveness of the teaching, learning and assessment strategies of mathematics in the classrooms of their respective schools, especially when a new curriculum for mathematics is introduced.

NAME OF SCHOOL: SCHOOL A, SCHOOL B OR SCHOOL C
NAME OF TEACHER: Please enter DAY, MONTH, YEAR of birth followed by initials.

EXAMPLE: 14071962HBT NAME OF TEACHER:
.....

MALE

FEMALE

Instructions:
1. Please score the statement by putting a **circle** around the appropriate response.
2. Only **one circle** per statement is allowed.

STATEMENTS:

1. When the grades of your learners improve in mathematics, is it more likely

- 1. because you found ways to motivate your learners, **or**
- 2. because your learners were trying harder to do well?

2. Suppose you had difficulties in setting up learning materials for your learners in your classroom. Would this probably happen

- 1. because you lacked the appropriate materials, **or**
- 2. because you didn't spend enough time in developing the relevant activities?

3. Suppose your learners did not appear to be benefiting from a more individualized method of instruction. The reason for this would probably be

1. because you were having some problems managing this type of instruction, **or**
2. because your learners were such that they needed a more traditional approach.

4. When a learner gets a better level in mathematics on his report card then he/she gets, is it

1. because he/she was putting more effort into his/her schoolwork, **or**
2. because you found better ways to teach him/her?

5. If the learners in your class became disruptive and noisy when you left them alone in the classroom for five minutes, would this happen

1. because you did not leave them interesting work to do while you were gone, **or**
2. because the learners were more noisy on that day than they usually are?

6. When some of your learners fail a mathematics test, it is more likely

1. because they were not paying attention to that particular lesson, **or**
2. because you did not use enough examples to illustrate the concept.

7. Suppose you were successful using alternative teaching and learning strategies in your class of about 40 learners. Would this occur

1. because you worked hard at it, **or**
2. because your learners easily conformed to the new classroom procedure?

8. When a learner pulls his/her level up from a “3” to a “5”, it is more likely

1. because you came up with an idea to motivate the learner, **or**
2. because the learner was trying harder to do well.

9. Suppose you are teaching a learner a ‘difficult’ concept in algebra, data handling or any other discipline and the learner has trouble understanding it. Would this happen

1. because the learner was not able to understand it, **or**
2. because you could not explain it very well?

10. When a learner does better in mathematics than what he/she usually does, is it more likely

1. because the learner was trying harder, **or**
2. because you tried hard to encourage the learner to do better.

11. If you could not keep your class quite, it would probably be

1. because the learners came to school more rowdy than usual, **or**
2. because you were so frustrated that you were not able to settle them down.

12. Suppose the average of your learners is higher than the average of the learners taught by another teacher. Would it be

1. because you put in a lot of teaching effort as the mathematics teacher, **or**
2. because your learners were more co-operative than the other learners?

13. Suppose it was a week before the holidays and you were having some trouble keeping order in your classroom. This would more likely happen

1. because you were not putting extra effort into keeping the learners under control, **or**
2. because the learners were more uncontrollable than usual.

14. If one of your learners could not do a class assignment, would it be

1. because the learner was not paying attention during the class lesson, **or**
2. because you gave the learner an assignment that was above his/her level?

15. Suppose you wanted to teach a series of graph lessons, but the lessons did not turn out as well as you had expected. This would more likely to happen

1. because the learners were not interested in learning about graphs, **or**
2. because you did not put enough effort into developing the lessons.

16. Suppose a learner who does not typically participate in class begins to volunteer his/her answers. This would happen

1. because the learner finally encountered a topic of interest to him/her, **or**
2. because you tried hard to encourage the learner to volunteer his/her answers.

17. Suppose one of your learners cannot focus on a task for a particular assignment. Would this more likely to happen

1. because you gave the learner a task that was less interesting than most tasks, **or**
2. because the learner was unable to concentrate on his/her schoolwork that day?

18. Suppose you were unable to devise an instructional programme as requested by the Department of Education, which would accommodate the needs of individual learners in your class. This would most likely happen

1. because there were too many learners in your class, **or**
2. because you did not have enough knowledge or experience with individualized instructional programmes.

19. If the learners in your class perform better than they usually do in a mathematics test, would this happen

1. because the learners studied a lot for the test, **or**
2. because you did a good job of teaching the subject area?

20. When the performance of a learner in your class appears to be slowly deteriorating, it is usually

1. because you were not trying hard enough to motivate him/her, **or**
2. because the learner was putting less effort into his/her schoolwork.

21. Suppose a new learner was assigned to your class and this learner had a difficult time making friends with his/her classmates. Would it more likely

1. that most of the other learners did not make an effort to be friends with the new learner, **or**
2. that you were not trying hard enough to encourage the other learners to be more friendly toward the newcomer?

22. If a learner in your present class performed better in the external examination at the end of the year compared to learners you had the previous year, it would probably be

1. because you put more effort into teaching this year, **or**
2. because this year's class of learners were somewhat smarter than those last year.

23. Suppose, one day, you find yourself reprimanding one of your learners more often than usual. Would this be more likely to happen

1. because that learner was misbehaving more than usual that day, **or**
2. because you were somewhat less tolerant?

24. Suppose one of your under-achievers does him/her homework better than usual. This would probably happen

1. because the learner tried hard to do the assignment, **or**
2. because you tried hard to explain how to do the assignment.

25. Suppose one of your learners began to do better in mathematics than he/she usually did. Would this happen

1. because you put much effort into helping the learner do better, **or**
2. because the learner was trying harder to do well in mathematics?

Questionnaire adapted from Rose, J.S. & Medway, F.J. (1981). Measurements of teachers' beliefs in their control over student outcome. *Journal of Educational Research* (74), 185-190.

APPENDIX B2: MATHEMATICS TEACHERS SELF-EFFICACY SPREADSHEETS

MATHEMATICS TEACHERS SELF-EFFICACY SPREADSHEET (APPENDIX B2)																											
NAME OF SCHOOL: SCHOOL A																											
		STATEMENTS																									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
	TEACHER'S CONTROL	1	2	1	2	1	2	1	1	2	2	2	1	1	2	2	2	1	2	2	1	2	2	1	2	2	1
1		1	1	1	1	2	1	1	1	1	2	1	2	2	1	1	2	1	1	1	1	2	2	1	1	1	
2		1	1	2	2	2	2	1	1	1	2	1	1	2	1	1	2	2	2	1	2	2	1	1	1	1	
3		2	1	2	1	1	2	2	2	2	1	2	2	1	2	2	1	2	2	1	2	1	1	2	2	1	
4		1	1	2	1	1	1	2	2	2	1	1	1	1	2	2	1	1	2	2	1	2	1	1	1	1	
5		2	1	1	1	2	1	1	1	1	2	2	2	1	2	2	1	1	1	1	2	1	2	1	2	1	

MATHEMATICS TEACHERS SELF-EFFICACY SPREADSHEET (APPENDIX B2)																											
NAME OF SCHOOL: SCHOOL B																											
		STATEMENTS																									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
	TEACHER'S CONTROL	1	2	1	2	1	2	1	1	2	2	2	1	1	2	2	2	1	2	2	1	2	2	1	2	2	1
1		1	1	2	2	2	2	1	2	1	2	1	2	1	1	1	1	2	1	2	1	1	1	1	2	2	
2		1	1	2	1	1	1	1	1	1	2	1	2	1	1	1	2	1	2	2	2	2	2	1	1	1	
3		1	1	2	1	1	1	1	2	1	2	1	1	2	1	1	2	1	1	2	2	1	1	1	2	1	
4		2	2	2	1	1	2	1	2	2	2	2	1	1	1	2	1	2	1	2	1	1	2	1	2	1	
5		1	1	2	2	2	1	1	1	1	2	1	1	2	1	2	2	1	1	2	2	2	1	1	1	2	
6		2	2	2	2	1	1	1	1	1	1	1	1	2	2	1	2	2	1	2	2	1	1	1	1	2	

MATHEMATICS TEACHERS SELF-EFFICACY SPREADSHEET (APPENDIX B2)																										
NAME OF SCHOOL: SCHOOL C																										
		STATEMENTS																								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	TEACHER'S CONTROL	1	2	1	2	1	2	1	1	2	2	2	1	1	2	2	2	1	2	2	1	2	1	2	2	1
1		1	2	1	1	1	2	1	2	2	2	2	2	1	1	2	2	2	2	1	2	1	1	1	2	2
2		1	1	1	2	1	1	1	1	2	2	1	1	1	1	2	2	1	2	2	1	2	2	1	2	1
3		1	1	2	1	2	1	2	1	1	2	1	1	2	1	1	2	2	1	2	2	1	2	1	1	1
4		2	1	2	1	2	2	1	2	2	2	1	2	1	1	1	2	2	1	1	1	1	2	1	1	2
5		1	2	2	2	1	2	1	1	2	2	2	1	1	2	2	2	1	1	2	1	2	1	2	2	1

APPENDIX C: INTERVIEW QUESTIONS FOR MATHEMATICS TEACHERS

The purpose of this questionnaire is to illicit responses from mathematics teachers who teach in schools situated in previously disadvantaged communities, in order to gage if mathematics efficacy affect mathematics teachers in terms of their teaching and learning strategies.

NAME OF SCHOOLS: SCHOOL A, SCHOOL B AND SCHOOL C

**NAME OF TEACHERS: TEACHER A₁, TEACHER A₂, TEACHER B₁,
TEACHER B₂, TEACHER C₁ AND TEACHER C₂**

MALE

FEMALE

**Theme 1: *Teachers' understanding of the concept of outcomes- based education*
(OBE)**

Question 1: *What does outcomes-based education mean to you as a mathematics educator?*

Response:

Question 2: *In your experience with outcomes-based education, what are the challenges in having an outcomes-based approach to (a) teaching strategies (b) learning strategies (c) assessment strategies?*

Response: (a) teaching strategies:

(b) learning strategies:

(c) assessment strategies:

How do you respond to these challenges as a mathematics teacher?

Response:

<p><u>Theme 2:</u> <i>Teachers' understanding of a new curriculum statement in mathematics</i></p>

Question 3: *In your opinion where do you think are the most significant changes of the new curriculum for mathematics in grade 11?*

Response:

Do these changes add value to a better understanding of mathematics? Please elaborate.

Response:

Question 4: *Is the new curriculum in grade 11 easier or more challenging to complete than the old NATED550 curriculum? Why do you think that is the case?*

Response:

Based on your previous response, in which areas of the new mathematics curriculum do you think have the degree of difficulty improved or declined? Please elaborate.

Response:

Question 5: *Which of the disciplines of mathematics (Algebra, Trigonometry, Analytical Geometry, Transformation Geometry, Data Handling and Surface Area & Volume) do your learners understand better and which are the areas that they battle with? Why do you think that is the case?*

Response:

Did these changes impact positively or negatively on the pass rate of your grade 11 learners in the final external examination last year? Please elaborate.

Response:

<u>Theme 3:</u> <i>Teachers' expositions of mathematics in the schools where they teach?</i>

Question 6: *In your opinion, is there a willingness from the mathematics teachers in your school to teach with commitment, irrespective of the impact of negative external factors (e.g. lack of textbooks and other resources, overcrowding etc.). Why do you think that is the case?*

Response:

Question 7: *Did all the mathematics teachers in your school receive in-service training from subject advisors from the Department of Education regarding the content of the new curriculum?*

Response:

If no, why not and what could be done to improve the teaching strategies of these teachers?

Response:

If yes, was the training effective and relevant to the topics in the curriculum? Are there other alternatives to strengthen teaching efficiency in your school?

Response:

Question 8: *Outcomes-based education (OBE) requires from teachers to have a learner-centred approach to teaching, learning and assessment as oppose to a teacher-directed approach ? In your experience does an outcomes-based approach in teaching contributes to a better understanding in mathematics or not? Please elaborate.*

Response:

Question 9: *If learners in one of the classes under-perform in mathematics, who in your opinion should be held accountable for the poor results, an ineffective teacher **OR** learners with negative learning attitudes **OR** both? Please elaborate.*

Response:

Question 10: *What, in your opinion, could be done by the management of your school if the results for mathematics are much higher than anticipated?*

Response:

Should appraisals/incentives for both teachers and learners be introduced to show appreciation? Motivate your answer.

Response:

Question 11: *What support structures are in or outside of your school to support learners who are struggling with mathematics?*

Response:

If any, are these support structures effective? Please elaborate.

Response:

Question 12: *If you were teaching at a more affluent school, will you get better results in mathematics as oppose to where you teach now **OR** do good results only depend on the quality of the mathematics teacher and the dedication of the learners irrespective in what school you teach? Please elaborate.*

Response:

THE END OF THE INTERVIEW!!!

APPENDIX C3: TRANSCRIPTIONS OF THE SEMI-STRUCTURED INTERVIEWS

All the interviews that are conducted start with the same introduction to make the interviewees aware about what the interview is about, the themes that are addressed in the interview and the ethical principle of confidentiality that guide the interview. The credibility of the mathematics educators as well as the educational institutions is therefore guaranteed. This introduction will be done for all the interviews, but be transcribed only once and read as follows:

These interviews are conducted to collect data from grade eleven mathematics teachers of the sample schools, situated in previously disadvantaged communities, to give insight into three themes in order to gauge how mathematics efficacy affect these mathematics teachers in terms of their own teaching and learning strategies. This mathematics teacher that is interviewed is, for ethical reasons, be referred to as Teacher A₁. This interview is conducted in School A.

4.5.1 Mathematics teachers of School A (n=2)

- **Interview with Teacher A₁**

<u>Theme 1:</u> <i>Teachers' understanding of the concept of outcomes-based education (OBE)</i>
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Question 1: *What does outcomes-based education mean to you as a mathematics educator?*

Response: Not much. The teaching of mathematics has always been interactive and attempts are always made to accommodate learners at different levels.

Question 2: *In your experience with outcomes-based education, what are the challenges in having an outcomes-based approach to (a) teaching strategies (b) learning strategies (c) assessment strategies?*

Response: (a) teaching strategies: too much teaching time get wasted on administrative work.

(b) learning strategies: many learners don't have access to resource materials.

(c) assessment strategies: there is too much paper work and administration.

How do you respond to these challenges as a mathematics teacher?

Response: You just have to plan your teaching time better to make sure all the work in the pace-setter is completed.

<u>Theme 2:</u> <i>Teachers' understanding of a new curriculum statement in mathematics</i>
--

Question 3: *In your opinion where do you think are the most significant changes of the new curriculum for mathematics in grade 11?*

Response: The removal of Euclidean Geometry from the compulsory syllabus.

Do these changes add value to a better understanding of mathematics? Please elaborate.

Response: No. The ability to solve geometry problems using diagrams aids the learner to develop logical thinking.

Question 4: *Is the new curriculum in grade 11 easier or more challenging to complete than the old NATED 550 curriculum? Why do you think that is the case?*

Response: It is easier to complete since less time is now spent on topics like Transformation Geometry and Data Handling as compared to Euclidean Geometry.

Based on your previous response, in which areas of the new mathematics curriculum do you think have the degree of difficulty improved or declined? Please elaborate.

Response: The mathematics has become easier in certain areas like Transformation Geometry and Data Handling, but learners still battles with Trigonometry.

Question 5: *Which of the disciplines of mathematics (Algebra, Trigonometry, Analytical Geometry, Transformation Geometry, Data Handling and Surface Area & Volume) do your learners understand better and which are the areas that they battle with? Why do you think that is the case?*

Response: They grasp Transformation Geometry and Data Handling more easily. Learners still struggle with Trigonometry and certain parts of Algebra.

Did these changes impact positively or negatively on the pass rate of your grade 11 learners in the final external examination last year? Please elaborate.

Response: A little of both. The mathematics has become easier in certain aspects, but the amount of work makes it difficult to complete the syllabus.

Theme 3: Teachers' expositions of mathematics in the schools where they teach?

Question 6: *In your opinion, is there a willingness from the mathematics teachers in your school to teach with commitment, irrespective of the impact of negative external factors (e.g. lack of textbooks and other resources, overcrowding etc.). Why do you think that is the case?*

Response: Yes. We have a dedicated group of mathematics teachers.

Question 7: *Did all the mathematics teachers in your school receive in-service training from subject advisors from the Department of Education regarding the content of the new curriculum?*

Response: Yes. All the mathematics teachers received training.

Was the training effective and relevant to the topics in the curriculum? Are there other alternatives to strengthen teaching efficiency in your school?

Response: Yes, the training was effective.

Question 8: *Outcomes-based education (OBE) requires from teachers to have a learner-centred approach to teaching, learning and assessment as oppose to a teacher-directed approach. In your experience does an outcomes-based approach in teaching contribute to a better understanding of mathematics or not? Please elaborate.*

Response: No. Teaching of mathematics has not changed much with the introduction of OBE.

Question 9: *If learners in one of the classes under-perform in mathematics, who in your opinion should be held accountable for the poor results, an ineffective teacher **OR** learners with negative learning attitudes **OR** both? Please elaborate.*

Response: It is difficult to say. At the end of the day, I suppose the teacher is always accountable.

Question 10: *What, in your opinion, could be done by the management of your school if the results for mathematics are much higher than anticipated?*

Response: To acknowledge both the efforts of both the teacher and the learners.

Should appraisals/incentives for both teachers and learners be introduced to show appreciation? Motivate your answer.

Response: Incentives for the learners should be in place so as to encourage learners to always to their best.

Question 11: *What support structures are in or outside of your school to support learners who are struggling with mathematics?*

Response: None that I know of.

Question 12: *If you were teaching at a more affluent school, will you get better results in mathematics as oppose to where you teach now **OR** do good results only depend on the quality of the mathematics teacher and the dedication of the learners irrespective in what school you teach? Please elaborate.*

Response: The socio-economic background of our learners has a huge impact on their results. Many of our learners have added responsibilities at home (chores like looking after siblings) and do not have much time to dedicate to their studies. We therefore have two or more learners who do well, while more affluent schools have a greater percentage of their learners excelling.

- **Interview with Teacher A₂**

Theme 1: *Teachers' understanding of the concept of outcomes- based education*

(OBE)

Question 1: *What does outcomes-based education mean to you as an mathematics educator?*

Response: It is a method of teaching that focuses on what learners actually do after they are taught. The desired outcome is selected first and the curriculum is created to support the intended outcome.

Question 2: *In your experience with outcomes-based education, what are the challenges in having an outcomes-based approach to (a) teaching strategies (b) learning strategies (c) assessment strategies?*

Response: (a) teaching strategies: to set the desired outcomes before the lesson and actually achieving those outcomes.

(b) learning strategies: some learners are not motivated to learn by themselves.

(c) assessment strategies: some learners struggle in tests and do not hand in their projects and assignments in time.

How do you respond to these challenges as a mathematics teacher?

Response: By being firm and teach them self-discipline.

Theme 2: *Teachers' understanding of a new curriculum statement in mathematics*

Question 3: *In your opinion where do you think are the most significant changes of the new curriculum for mathematics in grade 11?*

Response: The introduction of Linear Programming which was only taught in the Higher Grade in the old syllabus, also the introduction of new topics such as Transformation Geometry and Data Handling.

Do these changes add value to a better understanding of mathematics? Please elaborate.

Response: No, certain learners still battle to understand and apply certain concepts when they have to solve problems.

Question 4: *Is the new curriculum in grade 11 easier or more challenging to complete than the old NATED 550 curriculum? Why do you think that is the case?*

Response: More challenging, because the syllabus is more advanced.

Based on your previous response, in which areas of the new mathematics curriculum do you think have the degree of difficulty improved or declined? Please elaborate.

Response: The degree of difficulty has improved, because learners don't perform as they should.

Question 5: Which of the disciplines of mathematics (Algebra, Trigonometry, Analytical Geometry, Transformation Geometry, Data Handling and Surface Area & Volume) do your learners understand better and which are the areas that they battle with? Why do you think that is the case?

Response: I think learners understand Algebra better. Transformation Geometry is the most difficult part.

Did these changes impact positively or negatively on the pass rate of your grade 11 learners in the final external examination last year? Please elaborate.

Response: I think negatively, because the learners did not perform well in the external examination.

<u>Theme 3:</u> Teachers' expositions of mathematics in the schools where they teach?
--

Question 6: In your opinion, is there a willingness from the mathematics teachers in your school to teach with commitment, irrespective of the impact of negative external factors (e.g. lack of textbooks and other resources, overcrowding etc.). Why do you think that is the case?

Response: Yes, because the teachers care for the welfare of the learners.

Question 7: *Did all the mathematics teachers in your school receive in-service training from subject advisors from the Department of Education regarding the content of the new curriculum?*

Response: No.

Why not and what could be done to improve the teaching strategies of these teachers?

Response: Some of them are new teachers. The experienced teachers must give guidance and support to the new teachers.

Question 8: *Outcomes-based education (OBE) requires from teachers to have a learner-centred approach to teaching, learning and assessment as oppose to a teacher-directed approach. In your experience does an outcomes-based approach in teaching contribute to a better understanding of mathematics or not? Please elaborate.*

Response: Not really, because the learners still struggle to understand mathematics. It was the same with the old syllabus.

Question 9: *If learners in one of the classes under-perform in mathematics, who in your opinion should be held accountable for the poor results, an ineffective teacher **OR** learners with negative learning attitudes **OR** both? Please elaborate.*

Response: I think learners with negative learning attitudes are responsible for poor results.

Question 10: *What, in your opinion, could be done by the management of your school if the results for mathematics are much higher than anticipated?*

Response: Motivate the teachers to maintain the trend.

Should appraisals/incentives for both teachers and learners be introduced to show appreciation? Motivate your answer.

Response: Yes, especially to learners who get very good marks in the examinations.

Question 11: *What support structures are in or outside of your school to support learners who are struggling with mathematics?*

Response: Extra lessons

Are these support structures effective? Please elaborate.

Response: Extra lessons are effective for slow learners; because more time can be spend to explain difficult concepts.

Question 12: *If you were teaching at a more affluent school, will you get better results in mathematics as oppose to where you teach now **OR** do good results only depend on the quality of the mathematics teacher and the dedication of the learners irrespective in what school you teach? Please elaborate.*

Response: Results will depend on the teacher and the background of the learners. Most of the learners who are learning here are having social problems. Model C learners perform better than our learners, because they go for private tuition. It also depends on the attitude and the interest of the learner.

4.5.2 Mathematics teachers of School B (n=2)

- **Interview with Teacher B₁**

<p><u>Theme 1:</u> <i>Teachers' understanding of the concept of outcomes- based education</i> (OBE)</p>

Question 1: *What does outcomes-based education mean to you as a mathematics educator?*

Response: You should teach in such a manner that your learners gradually grasp the concept themselves by seeing the link between existing and newly acquired knowledge.

Question 2: *In your experience with outcomes-based education, what are the challenges in having an outcomes-based approach to (a) teaching strategies (b) learning strategies (c) assessment strategies?*

Response: (a) teaching strategies: you cannot leave it entirely up to the learners to achieve the outcome.

(b) learning strategies: learners should take part actively and involve themselves, if they don't they run the risk of not achieving the outcome.

(c) assessment strategies: clearer guidelines should be given on how and which assessment strategies should be used.

How do you respond to these challenges as a mathematics teacher?

Response: In mathematics the question-answer method is most common. It is clearly set out what is it you want to achieve, and make sure learners take responsibility for their own learning.

<u>Theme 2:</u> <i>Teachers' understanding of a new curriculum statement in mathematics</i>
--

Question 3: *In your opinion where do you think are the most significant changes of the new curriculum for mathematics in grade 11?*

Response: Space, Shape and Measurement as well as Data Handling.

Do these changes add value to a better understanding of mathematics? Please elaborate.

Response: Yes, definitely. Geometry was more abstract and learners struggled most with the theorems, while Data Handling can be seen as bonus points, if learners have a clear understanding.

Question 4: *Is the new curriculum in grade 11 easier or more challenging to complete than the old NATED 550 curriculum? Why do you think that is the case?*

Response: It is more challenging. The Euclidean Geometry was omitted, yet quite a few new concepts were added to the curriculum, which learners are still struggling with.

In which areas of the new mathematics curriculum do you think have the degree of difficulty improved or declined? Please elaborate.

Response: The learners basically struggle with Trigonometry and then graphs in Algebra.

Question 5: *Which of the disciplines of mathematics (Algebra, Trigonometry, Analytical Geometry, Transformation Geometry, Data Handling and Surface Area & Volume) do your learners understand better and which are the areas that they battle with? Why do you think that is the case?*

Response: The learners understand Algebra, Analytical Geometry and Data Handling better. Yet they struggle with Trigonometry and Surface Area and Volume.

Did these changes impact positively or negatively on the pass rate of your grade 11 learners in the final external examination last year? Please elaborate.

Response: It influences them negatively. There is too much work to handle and little time. By the time the learners have to write the external examination, certain topics have not been covered extensively.

<u>Theme 3:</u> <i>Teachers' expositions of mathematics in the schools where they teach?</i>

Question 6: *In your opinion, is there a willingness from the mathematics teachers in your school to teach with commitment, irrespective of the impact of negative external factors (e.g. lack of textbooks and other resources, overcrowding etc.). Why do you think that is the case?*

Response: Yes. Even as a maths teacher I do not have adequate resources to assist with the teaching of the subject, I find it alarming that the number mathematics learners drop annually. I fear the subject might die a slow death or become extinct at my school.

Question 7: *Did all the mathematics teachers in your school receive in-service training from subject advisors from the Department of Education regarding the content of the new curriculum?*

Response: Yes, all the teachers received training.

Was the training effective and relevant to the topics in the curriculum? Are there other alternatives to strengthen teaching efficiency in your school?

Response: Yes. The training was effective and prepared us for the new curriculum.

Question 8: *Outcomes-based education (OBE) requires from teachers to have a learner-centred approach to teaching, learning and assessment as oppose to a teacher-directed approach. In your experience does an outcomes-based approach in teaching contribute to a better understanding of mathematics or not? Please elaborate.*

Response: Yes. If lessons are well planned and implemented correctly, than learners will understand better, because they are part of the process. Content knowledge are not just given to them, they have to use the content to acquire new knowledge.

Question 9: *If learners in one of the classes under-perform in mathematics, who in your opinion should be held accountable for the poor results, an ineffective teacher **OR** learners with negative learning attitudes **OR** both? Please elaborate.*

Response: Both. As a teacher one must find alternative methods to improve learners' attitudes towards the subject. Not all the learners that struggle should be seen as lost causes. Learners should also be self-motivated to do better and achieve more.

Question 10: *What, in your opinion, could be done by the management of your school if the results for mathematics are much higher than anticipated?*

Response: The efforts of both teachers and learners must be acknowledged. For teachers, a thank you-note or special mention in the assembly will mean a lot. Also award certificates should be given to learners in a special assembly and a special mention should be made of their achievements. They should be encouraged to do better.

Should appraisals/incentives for both teachers and learners be introduced to show appreciation? Motivate your answer.

Response: Yes, I think so. As human beings we all thrive on being acknowledged for our efforts, and if others recognize that we are motivated, we will do even better.

Question 11: *What support structures are in or outside of your school to support learners who are struggling with mathematics?*

Response: Most of the teachers offer extra classes as an improvement plan to assist learners.

Are these support structures effective? Please elaborate.

Response: Only those learners that are serious will take note what is serious to them. It does help certain learners that are serious about their futures. Some learners do not see the need for these classes and don't attend.

Question 12: *If you were teaching at a more affluent school, will you get better results in mathematics as oppose to where you teach now **OR** do good results only depend on the quality of the mathematics teacher and the dedication of the learners irrespective in what school you teach? Please elaborate.*

Response: Results will be better in a more affluent school, because those schools have more support structures like extra classes. The parents and the learners are motivated to do better and achieve more. Their learning environment is also more pleasing to assist with effective learning.

- **Interview with Teacher B₂**

Theme 1: *Teachers' understanding of the concept of outcomes- based education*

(OBE)

Question 1: *What does outcomes-based education mean to you as a mathematics educator?*

Response: Outcomes-based education is learner-centred teaching for an example group work.

Question 2: *In your experience with outcomes-based education, what are the challenges in having an outcomes-based approach to (a) teaching strategies (b) learning strategies (c) assessment strategies?*

Response: (a) teaching strategies: teaching must be learner-centred; it must involve learners more in the activities.

(b) learning strategies: learners can work as individuals or in groups in activities such as projects and investigations.

(c) assessment strategies: Tests, investigations and projects are time consuming and make it difficult to keep up with the pace setter.

How do you respond to these challenges as a mathematics teacher?

Response: Just stick to the teaching programme and make sure that assessment tasks are marked in good time.

Theme 2: Teachers' understanding of a new curriculum statement in mathematics

Question 3: *In your opinion where do you think are the most significant changes of the new curriculum for mathematics in grade 11?*

Response: Statistics are new and Euclidean Geometry has been omitted.

Do these changes add value to a better understanding of mathematics? Please elaborate.

Response: Yes and No.

Yes, because statistics are applied in real life situations.

No, because Euclidean Geometry has an effect on thinking ability.

Question 4: *Is the new curriculum in grade 11 easier or more challenging to complete than the old NATED 550 curriculum? Why do you think that is the case?*

Response: It is more challenging, because the learners don't understand the work.

In which areas of the new mathematics curriculum do you think have the degree of difficulty improved or declined? Please elaborate.

Response: The work is more difficult, especially in Trigonometry and Functions (mainly the second degree types).

Question 5: Which of the disciplines of mathematics (Algebra, Trigonometry, Analytical Geometry, Transformation Geometry, Data Handling and Surface Area & Volume) do your learners understand better and which are the areas that they battle with? Why do you think that is the case?

Response: Responses are poor in Trigonometry, Sequences and Graphs.

Did these changes impact positively or negatively on the pass rate of your grade 11 learners in the final external examination last year? Please elaborate.

Response: Negatively, because the learners just don't perform and that impact on their attitudes towards mathematics.

Theme 3: Teachers' expositions of mathematics in the schools where they teach?

Question 6: In your opinion, is there a willingness from the mathematics teachers in your school to teach with commitment, irrespective of the impact of negative external factors (e.g. lack of textbooks and other resources, overcrowding etc.). Why do you think that is the case?

Response: Yes. Teachers are all committed, but not all the learners.

Question 7: *Did all the mathematics teachers in your school receive in-service training from subject advisors from the Department of Education regarding the content of the new curriculum?*

Response: Yes, all the mathematics teachers received training.

Was the training effective and relevant to the topics in the curriculum? Are there other alternatives to strengthen teaching efficiency in your school?

Response: Yes the training was effective, but there are no other alternatives in the school to strengthen teaching efficiency.

Question 8: *Outcomes-based education (OBE) requires from teachers to have a learner-centred approach to teaching, learning and assessment as oppose to a teacher-directed approach. In your experience does an outcomes-based approach in teaching contribute to a better understanding of mathematics or not? Please elaborate.*

Response: Yes, but the syllabus is changing again.

Question 9: *If learners in one of the classes under-perform in mathematics, who in your opinion should be held accountable for the poor results, an ineffective teacher **OR** learners with negative learning attitudes **OR** both? Please elaborate.*

Response: Both, because teachers fail to motivate learners.

Question 10: *What, in your opinion, could be done by the management of your school if the results for mathematics are much higher than anticipated?*

Response: Hard work from teachers and learners should be appreciated.

Should appraisals/incentives for both teachers and learners be introduced to show appreciation? Motivate your answer.

Response: Yes, both teachers and learners should be encouraged.

Question 11: *What support structures are in or outside of your school to support learners who are struggling with mathematics?*

Response: Special classes from teachers.

Are these support structures effective? Please elaborate.

Response: These classes will only be effective if the attitude of the learners towards their school work improves.

Question 12: *If you were teaching at a more affluent school, will you get better results in mathematics as oppose to where you teach now **OR** do good results only depend on the quality of the mathematics teacher and the dedication of the learners irrespective in what school you teach? Please elaborate.*

Response: Results will be different depending on the learners' attitude, ability and dedication. Social circumstances also affect results. My results will be better at a more affluent school.

4.5.3 Mathematics teachers of School C (n=2)

- **Interview with Teacher C₁**

Theme 1: Teachers' understanding of the concept of outcomes- based education

(OBE)

Question 1: *What does outcomes-based education mean to you as a mathematics educator?*

Response: OBE is learner-centred, so all the teaching efforts must be to the benefit of the learner.

Question 2: *In your experience with outcomes-based education, what are the challenges in having an outcomes-based approach to (a) teaching strategies (b) learning strategies (c) assessment strategies?*

Response: (a) teaching strategies: over-crowded classrooms make it difficult to pay individual attention to learners.
(b) learning strategies: a lack of textbooks make it difficult for learners to learn.
(c) assessment strategies: negative attitudes towards assessment tasks are major challenges.

How do you respond to these challenges as a mathematics teacher?

Response: I always try my best to give individual attention, but it is really difficult.

<u>Theme 2:</u> <i>Teachers' understanding of a new curriculum statement in mathematics</i>
--

Question 3: *In your opinion where do you think are the most significant changes of the new curriculum for mathematics in grade 11?*

Response: Financial Mathematics, Data Handling and Transformation Geometry came in, while Euclidean Geometry is out.

Do these changes add value to a better understanding of mathematics? Please elaborate.

Response: Yes, Paper 2 is easier than Paper 2 in NATED550, but the learners still struggle.

Question 4: *Is the new curriculum in grade 11 easier or more challenging to complete than the old NATED 550 curriculum? Why do you think that is the case?*

Response: It is more challenging to complete, because Financial Maths and Functions are challenging for them.

In which areas of the new mathematics curriculum do you think have the degree of difficulty improved or declined? Please elaborate.

Response: Data Handling is easier for them, but they struggle with the other topics.

Question 5: *Which of the disciplines of mathematics (Algebra, Trigonometry, Analytical Geometry, Transformation Geometry, Data Handling and Surface Area & Volume) do your learners understand better and which are the areas that they battle with? Why do you think that is the case?*

Response: They understand Data Handling, but they battle with Financial Maths, Trigonometry and Functions.

Did these changes impact positively or negatively on the pass rate of your grade 11 learners in the final external examination last year? Please elaborate.

Response: Negatively, because they struggle with new and changed topics.

<u>Theme 3:</u> <i>Teachers' expositions of mathematics in the schools where they teach?</i>

Question 6: In your opinion, is there a willingness from the mathematics teachers in your school to teach with commitment, irrespective of the impact of negative external factors (e.g. lack of textbooks and other resources, overcrowding etc.). Why do you think that is the case?

Response: Yes. We got hardworking and dedicated teachers.

Question 7: *Did all the mathematics teachers in your school receive in-service training from subject advisors from the Department of Education regarding the content of the new curriculum?*

Response: Yes.

Was the training effective and relevant to the topics in the curriculum? Are there other alternatives to strengthen teaching efficiency in your school?

Response: Yes, the training was effective.

Question 8: *Outcomes-based education (OBE) requires from teachers to have a learner-centred approach to teaching, learning and assessment as oppose to a teacher-directed approach. In your experience does an outcomes-based approach in teaching contribute to a better understanding of mathematics or not? Please elaborate.*

Response: I think mathematics learners need more patience and practice, so that a learner-centred approach will help them for a better understanding of the subject.

Question 9: *If learners in one of the classes under-perform in mathematics, who in your opinion should be held accountable for the poor results, an ineffective teacher **OR** learners with negative learning attitudes **OR** both? Please elaborate.*

Response: Both. We need both qualified teachers and dedicated learners to get good results.

Question 10: *What, in your opinion, could be done by the management of your school if the results for mathematics are much higher than anticipated?*

Response: Teachers and learners must be appreciated for their good efforts.

Should appraisals/incentives for both teachers and learners be introduced to show appreciation? Motivate your answer.

Response: Yes, they must be appreciated.

Question 11: *What support structures are in or outside of your school to support learners who are struggling with mathematics?*

Response: Extra classes are provided by the Education Department.

Are these support structures effective? Please elaborate.

Response: Not really, because some of the learners may not get a chance to attend extra classes, because these projects choose only the brilliant kids.

Question 12: *If you were teaching at a more affluent school, will you get better results in mathematics as oppose to where you teach now **OR** do good results only depend on the quality of the mathematics teacher and the dedication of the learners irrespective in what school you teach? Please elaborate.*

Response: Better results depend on good teachers and dedicated learners.

- **Interview with Teacher C₂**

Theme 1: *Teachers' understanding of the concept of outcomes- based education*

(OBE)

Question 1: *What does outcomes-based education mean to you as a mathematics educator?*

Response: It is a learner-centred approach which seeks to develop a child in totality.

Question 2: *In your experience with outcomes-based education, what are the challenges in having an outcomes-based approach to (a) teaching strategies (b) learning strategies (c) assessment strategies?*

Response: (a) teaching strategies: over-crowded classrooms complicate teaching.

(b) learning strategies: the school lacks proper learning materials like textbooks.

(c) assessment strategies: the learners are not motivated to prepare themselves for tests and examinations

How do you respond to these challenges as a mathematics teacher?

Response: I put them in specific groups so that the weak ones can benefit from the strong ones.

Theme 2: Teachers' understanding of a new curriculum statement in mathematics

Question 3: *In your opinion where do you think are the most significant changes of the new curriculum for mathematics in grade 11?*

Response: Euclidean Geometry has been taken out and Data Handling and Transformation Geometry have been introduced.

Do these changes add value to a better understanding of mathematics? Please elaborate.

Response: Yes. The learners are enjoying Paper 2 more than Paper 1.

Question4: *Is the new curriculum in grade 11 easier or more challenging to complete than the old NATED 550 curriculum? Why do you think that is the case?*

Response: Yes, it is more challenging to complete. There is a lot of work to complete and learners understand the work very slowly.

In which areas of the new mathematics curriculum do you think have the degree of difficulty improved or declined? Please elaborate.

Response: Definitely improved, especially in Financial Maths and Functions.

Question 5: Which of the disciplines of mathematics (Algebra, Trigonometry, Analytical Geometry, Transformation Geometry, Data Handling and Surface Area & Volume) do your learners understand better and which are the areas that they battle with? Why do you think that is the case?

Response: They understand Data Handling better and struggle with Financial Mathematics.

Did these changes impact positively or negatively on the pass rate of your grade 11 learners in the final external examination last year? Please elaborate.

Response: Negatively, because they get less marks for Paper 1.

<u>Theme 3:</u> Teachers' expositions of mathematics in the schools where they teach?
--

Question 6: In your opinion, is there a willingness from the mathematics teachers in your school to teach with commitment, irrespective of the impact of negative external factors (e.g. lack of textbooks and other resources, overcrowding etc.). Why do you think that is the case?

Response: Our maths teachers are hard workers.

Question 7: *Did all the mathematics teachers in your school receive in-service training from subject advisors from the Department of Education regarding the content of the new curriculum?*

Response: Yes, all of them received training.

Was the training effective and relevant to the topics in the curriculum? Are there other alternatives to strengthen teaching efficiency in your school?

Response: It was effective, but a lot could be done by subject advisors to improve the situation.

Question 8: *Outcomes-based education (OBE) requires from teachers to have a learner-centred approach to teaching, learning and assessment as oppose to a teacher-directed approach. In your experience does an outcomes-based approach in teaching contribute to a better understanding of mathematics or not? Please elaborate.*

Response: Yes, it does, but it needs a lot of time and both dedicated teachers and learners.

Question 9: *If learners in one of the classes under-perform in mathematics, who in your opinion should be held accountable for the poor results, an ineffective teacher **OR** learners with negative learning attitudes **OR** both? Please elaborate.*

Response: Both, because teachers are here to teach and learners are at school to learn.

Question 10: *What, in your opinion, could be done by the management of your school if the results for mathematics are much higher than anticipated?*

Response: Teachers and learners should be appreciated for the good work they do.

Should appraisals/incentives for both teachers and learners be introduced to show appreciation? Motivate your answer.

Response: Yes. Any token of appreciation will do, because it will motivate other teachers and learners.

Question 11: *What support structures are in or outside of your school to support learners who are struggling with mathematics?*

Response: Extra classes for learners.

Are these support structures effective? Please elaborate.

Response: These classes do not benefit all the learners, because they only choose the bright ones to participate in these programmes.

Question 12: *If you were teaching at a more affluent school, will you get better results in mathematics as oppose to where you teach now **OR** do good results only depend on the quality of the mathematics teacher and the dedication of the learners irrespective in what school you teach? Please elaborate.*

Response: Good results depend on the effort the learners put in their school work. They are the ones that must take responsibility for their own learning, irrespective in what school they are.

APPENDIX D: MATHEMATICS TEST FOR GRADE 12 LEARNERS
TIME: 1 HOUR 30 MINUTES

The purpose of the mathematics test is to assess effective teaching, learning and assessment strategies by mathematics teachers on Grade 11 mathematical content, and how that strategies that were implemented in Grade 11 translate itself into a more conceptual understanding of mathematics by learners.

NAME OF SCHOOLS: SCHOOL A, SCHOOL B AND SCHOOL C

NAME OF LEARNER: Please enter DAY, MONTH, YEAR of birth followed by INITIALS.

EXAMPLE: 15021993WWH NAME OF LEARNER:

.....

MALE

FEMALE

Instructions:

1. Please score the statements by putting a **circle** around the **appropriate response**.
2. Only **one circle** per statement is allowed.
3. All answers, where applicable, have been rounded off to **two decimal places**.
4. Learners are allowed to a scientific non-graphical calculator.
5. An additional **formula sheet** is provided to the respondents.

STATEMENT 1

The standard form of the quadratic function is defined as:

(1) $ax^2 + bx + c = 0$ (2) $y = ax^2 + bx + c$ (3) $y = \frac{a}{x-p} + q$ (4) $y = mx + c$

STATEMENT 2

The solution to the quadratic inequality $x^2 - 5x - 14 < 0$ is:

(1) $x > -2$ or $x < 7$ (2) $x < -2$ or $x > 7$ (3) $x < 2$ or $x > -7$ (4) $-2 < x < 7$

STATEMENT 3

The number pattern **3; 12; 27; 48 ...** is:

- (1) cubic (2) linear **(3) quadratic** (4) Fibonacci

STATEMENT 4

To calculate the effect of inflation on the rise of the price of bread, the following formula is used:

- (1) $A = P(1 - i)^n$ (2) $A = P(1 + i.n)$ **(3) $A = P(1 + i)^n$** (4) $A = P(1 - i.n)$

STATEMENT 5

In the function of the parabola defined as $y = a(x - p)^2 + q$ the value of **q** represents the:

- (1) y-intercept (2) x-intercept **(3) y-coordinate of the turning point** (4) shape of the function

STATEMENT 6

One of the following formulas that are applicable for the **gradients of perpendicular lines** is:

- (1) $m = \tan \theta$ **(2) $m_1 \times m_2 = -1$** (3) $m_1 = m_2$ (4) $m_1 \times m_2 = 1$

STATEMENT 7

The correct answer in surd form of $a^{\frac{1}{n}}$ is:

- (1) $\sqrt[n]{a}$** (2) $\sqrt[n]{a^n}$ (3) $\frac{1}{\sqrt[n]{a}}$ (4) $\frac{n}{\sqrt[n]{a}}$

STATEMENT 8

The value of **x** in the equation $2\sqrt{x - 3} = x - 3$ is:

- (1) -3 or 7 (2) 3 or -7 **(3) 3 or 7** (4) -3 or -7

STATEMENT 9

In the function of the hyperbola $y = \frac{a}{x-p} + q$ the value of p represents the:

- (1) x-intercept
- (2) asymptote on the x-axis**
- (3) x-coordinate of the turning point
- (4) y-intercept

STATEMENT 10

The formula $T_n = T_{n-1} + T_{n-2}$ if ($T_1 = 3$ and $T_2 = 5$), can only generate the following sequence:

- (1) 3;5;7;9;11
- (2) 3;5;8;13;21...**
- (3) 3;5;15;75;1125...
- (4) 3;5;3;5;3...

STATEMENT 11

The domain of a function f is defined as:

- (1) all possible x-values**
- (2) all possible y-values
- (3) both x and y values
- (4) a feasible region

STATEMENT 12

If the formula $1 + i_e = (1 + \frac{i^{(m)}}{m})^m$ is used to convert a nominal rate of 7% compounded quarterly to an effective annual interest rate, the answer is:

- (1) $i^{(4)} = 7,19\%$ p.a.
- (2) $i_e = 7\%$ p.a.
- (3) $i_e = 0,07\%$ p.a.
- (4) $i_e = 7,19\%$ p.a.**

STATEMENT 13

The formula for the **nth term** of the sequence: **3;7;11;15...** is:

- (1) $T_n = 3n + 2$
- (2) $T_n = 4n - 1$**
- (3) $T_n = 3n - 2$
- (4) $T_n = 4n + 1$

STATEMENT 14

The purchase price of a new vehicle is R280 000 on an auction. If the value of the vehicle depreciates after 4 years at a reducing-balance method of 18 % p.a., the value of the vehicle would be:

- (1) R140 000
- (2) R126 594,09**
- (3) R 135 519,63
- (4) R117 658,97

STATEMENT 15

If $P = 500x + 750y$ is an objective function in Linear Programming, then the gradient(m) to use for drawing the search line would be:

- (1) $m = \frac{2}{3}$ (2) $m = -\frac{2}{3}$ (3) $m = -\frac{3}{2}$ (4) $m = \frac{3}{2}$

STATEMENT 16

The following trigonometric operation will result in an answer of **1**:

- (1) $\sin^2 30^\circ + \cos^2 45^\circ$ (2) $\sin^2 30^\circ + \cos^2 30^\circ$ (3) $\sin^2 45^\circ - \cos^2 30^\circ$ (4) $\sin^2 30^\circ - \cos^2 30^\circ$

STATEMENT 17

If $\cos(\theta - 360^\circ)$ is to be expressed as a ratio of θ , the answer would be:

- (1) $\cos \theta$ (2) $\sin \theta$ (3) $-\cos \theta$ (4) $-\sin \theta$

STATEMENT 18

If $\cos \theta = \frac{-3}{5}$, and $180^\circ < \theta < 360^\circ$, the value of $\sin \theta + \cos \theta$ would be:

- (1) $\frac{-7}{5}$ (2) $\frac{-5}{7}$ (3) $\frac{7}{5}$ (4) $\frac{5}{7}$

STATEMENT 19

The ratio of $\frac{\sin \theta}{\cos \theta}$ is the quotient identity of:

- (1) $\tan \theta$ (2) $\frac{\cos \theta}{\sin \theta}$ (3) $\frac{1}{\tan \theta}$ (4) $-\tan \theta$

STATEMENT 20

If $\tan \theta = -\sqrt{3}$, then the general solution of θ would be:

- (1) $60^\circ + k.360$, $k \in Z$ (2) $60^\circ + k.180^\circ$, $k \in Z$ (3) $-60^\circ + k.180^\circ$, $k \in Z$ (4) $-60^\circ + k.360^\circ$, $k \in Z$

STATEMENT 21

To change $\sin(-\theta)$ into $-\sin \theta$, the following reduction formula is used:

- (1) $\sin(90^\circ - \theta)$ (2) $\sin(360^\circ - \theta)$ (3) $\sin(180^\circ - \theta)$ (4) $\sin(180^\circ + \theta)$

STATEMENT 22

In the trigonometric function of $f(x) = a \cos b \theta$, the a represents the:

- (1) asymptote (2) shape (3) period (4) amplitude

STATEMENT 23

The distance between the two points **A (-1;1)** and **B (1;3)** would be:

- (1) 8 units (2) 4 units (3) $2\sqrt{2}$ units (4) $\sqrt{5}$ units

STATEMENT 24

If the gradient of the line is **-2** and goes through the point **(1;3)**, the equation of the line would be:

- (1) $y = -2x + 5$ (2) $y = 2x - 5$ (3) $y = -2x - 5$ (4) $y = 2x + 5$

STATEMENT 25

The following lines: $y = 2x + 3$ and $y = -2x + 3$ would be:

- (1) parallel (2) sharing a y-intercept (3) perpendicular (4) the same line

STATEMENT 26

The co-ordinates of the **mid-point** of the line joining the points **A(-2; -3)** and **B(8;-11)** would be:

- (1) (6;-14) (2) (-5; -3) (3) (-10;8) (4) (3; -7)

STATEMENT 27

If the angle of inclination (θ) of a line is 135° then the gradient (m) of the line would be:

- (1) 1 (2) $\frac{1}{2}$ (3) -1 (4) $\frac{1}{\sqrt{2}}$

STATEMENT 28

The **reflection** of point **P(2;-3)** to **P'(-3;2)** was made possible in the following line:

- (1) $y = x$ (2) x - axis (3) $y = -x$ (4) y-axis

STATEMENT 29

If ΔABC with an area of 30mm^2 is **enlarged** through the origin by a **factor (k) of 2**, the area of the new $\Delta A'B'C'$ would be:

- (1) 900mm^2 (2) 90mm^2 **(3) 120mm^2** (4) 60mm^2

STATEMENT 30

If point **P(6; -5)** is translated in the rule **$(x;y) \rightarrow (x - 8; y + 7)$** , the new point **P'(x;y)** would be:

- (1) P'(-2; -12) **(2) P'(-2;2)** (3) P'(2;-2) (4) P'(2;2)

STATEMENT 31

The **box and whisker diagram** in data handling represents the central tendency of the:

- (1) median** (2) mode (3) mean (4) range

STATEMENT 32

The **mean** of the following set of data: **18 21 16 24 28 20 22 29 19 23** would be:

- (1) 20 (2) 19 (3) 23 **(4) 22**

STATEMENT 33

The **standard deviation** of the following same of data: **18 21 16 24 28 20 22 29 19 23** would be:

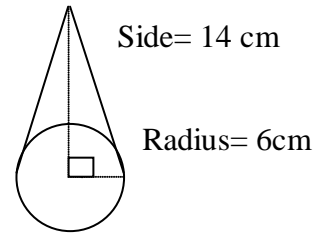
- (1) 2,65 **(2) 3,95** (3) 4,63 (4) 1,87

STATEMENT 34

Standard deviation is calculated in terms of **intervals** of the:

- (1) median (2) mode **(3) mean** (4) range

STATEMENT 35



If the volume of a cone is given as $V = \frac{1}{3} \times A \times H$, where A is the area of the cone and H is the slant height, the volume of this cone would be:

- (1) 113,10 cm³ (2) 476,86 cm³ (3) 527,79 cm³ (4) 263,76 cm³
-

APPENDIX D4: MATHEMATICS TEST SPREADSHEETS

MATHEMATICS TEST SPREADSHEET (APPENDIX D4)																																			
NAME OF SCHOOL: SCHOOL A																																			
STATEMENTS																																			
	ALGEBRA															TRIGONOMETRY					ANALYTICAL GEOMETRY				TRANSFORMATION GEOMETRY			DATA HANDLING			SURFACE AREA & VOLUME				
LEARNERS' RESPONSES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
MEMO	2	4	3	3	3	2	1	3	2	2	1	4	2	2	2	2	3	1	1	3	2	4	3	1	2	4	3	1	3	2	1	4	2	3	2
1	2	2	3	3	1	1	1	3	2	1	1	2	2	2	2	2	4	1	1	4	3	4	3	3	2	4	3	2	1	2	1	4	2	3	2
2	2	1	3	3	3	2	1	3	3	3	1	3	2	2	1	2	3	3	1	2	2	4	3	1	2	4	3	4	4	2	1	4	2	3	1
3	2	2	3	3	3	2	1	2	2	1	1	3	2	2	4	2	1	3	1	4	1	3	3	1	1	4	3	1	4	2	1	4	2	3	1
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7	2	4	3	3	3	2	2	3	2	1	1	4	2	2	3	2	3	1	1	4	2	4	3	1	2	4	3	1	3	2	1	4	2	3	2
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9	2	3	3	4	3	2	3	1	2	3	1	3	2	2	1	2	1	1	1	3	4	4	3	1	2	4	3	4	1	2	1	4	2	3	2
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11	2	4	3	3	1	2	1	4	3	2	1	4	2	2	3	4	1	2	1	3	4	4	3	1	2	4	3	4	4	2	1	4	2	3	4
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16	2	4	3	3	3	2	1	3	2	2	1	4	2	2	2	2	3	1	1	3	2	4	3	1	2	4	3	1	3	2	1	4	2	3	2
17	1	3	3	4	1	2	2	2	2	3	1	3	1	2	3	2	1	3	1	2	1	4	3	1	2	4	3	2	1	4	1	4	2	3	3
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21	1	3	3	2	1	2	2	3	1	2	1	3	4	2	2	4	1	1	1	4	4	4	3	3	2	4	3	3	1	1	1	4	2	3	4
22	2	4	3	3	1	2	3	1	2	3	1	4	2	2	3	2	4	3	1	2	3	4	2	1	3	4	3	1	1	3	1	4	2	3	2
23	1	4	3	3	2	2	2	2	2	1	1	4	2	2	2	1	2	4	1	4	1	4	3	2	2	4	3	4	3	2	1	4	2	3	3

MATHEMATICS TEST SPREADSHEET (APPENDIX D4)

NAME OF SCHOOL: SCHOOL B

		STATEMENTS																																		
		ALGEBRA										TRIGONOMETRY							ANALYTICAL GEOMETRY					TRANSFORMATION GEOMETRY					DATA HANDLING			SURFACE AREA & VOLUME				
LEARNERS' RESPONSES		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
MEMO		2	4	3	3	3	2	1	3	2	2	1	4	2	2	2	2	3	1	1	3	2	4	3	1	2	4	3	1	3	2	1	4	2	3	2
1		2	3	2	3	1	2	2	3	1	2	1	2	2	3	1	2	3	2	1	2	4	2	1	1	4	1	3	1	4	2	1	4	2	4	4
2		1	3	3	3	3	2	1	2	3	1	2	4	1	2	1	2	1	3	1	1	1	2	3	1	2	3	3	4	4	3	1	4	1	3	3
3		1	2	3	2	3	2	2	2	3	3	2	4	2	2	2	2	2	3	1	1	2	4	3	2	2	4	3	3	3	1	1	4	2	3	2
4		1	1	3	2	3	2	1	1	4	4	2	4	2	1	3	1	3	1	1	4	1	4	3	2	2	2	3	2	2	2	4	4	2	3	3
5		2	4	3	3	1	2	2	3	2	1	1	4	2	2	1	2	2	2	1	3	3	4	3	2	2	4	3	3	2	2	1	4	2	3	2
6		1	2	2	3	3	2	2	2	1	2	1	1	2	3	1	2	2	2	1	1	2	4	3	2	2	4	3	4	1	3	1	4	3	3	1
7		4	4	3	2	1	2	1	3	1	3	1	3	4	3	3	4	1	3	1	1	2	3	3	1	2	4	1	2	1	2	1	4	1	3	4
8		1	2	3	2	2	2	3	3	3	2	2	2	1	3	1	2	2	1	1	4	4	4	2	2	2	4	3	1	2	3	1	4	2	3	3
9		1	4	3	3	3	2	2	2	1	2	2	4	4	2	2	2	1	2	1	3	1	2	1	1	3	4	2	3	2	2	3	4	2	1	3
10		4	4	2	3	1	2	1	2	1	3	1	1	4	2	2	2	1	3	1	3	2	3	4	2	2	4	1	1	4	1	1	4	2	3	3
11		1	2	3	2	3	2	2	4	3	4	2	4	2	2	1	2	1	2	1	1	1	4	3	2	2	4	3	2	4	2	1	4	2	3	1
12		2	4	3	3	1	3	1	3	2	1	1	1	2	3	2	3	2	1	1	2	1	4	3	1	1	4	3	3	1	3	1	4	2	3	2
13		1	3	1	2	3	2	2	2	1	1	1	2	3	2	1	2	1	2	1	3	1	2	3	1	2	1	3	3	1	2	1	4	2	3	1
14		1	4	3	2	3	2	1	3	2	2	1	4	2	2	1	2	1	1	1	4	3	4	3	1	2	4	3	2	1	2	1	4	2	3	4
15		2	2	3	4	3	2	2	3	1	2	1	1	2	1	3	2	2	2	1	1	4	4	2	2	2	4	3	4	1	4	1	4	2	3	3
16		1	2	3	1	3	2	2	2	2	1	1	4	2	3	4	3	2	3	1	3	3	4	2	1	4	4	3	2	4	4	1	4	2	3	1
17		2	4	3	2	4	2	1	2	2	3	1	2	3	3	1	2	2	2	1	2	1	4	3	2	2	4	3	1	1	3	1	4	2	3	2
18		2	4	3	3	3	2	1	3	2	1	2	3	2	2	1	3	1	2	2	4	1	1	3	4	3	1	3	2	1	4	2	3	2		
19		1	2	3	4	1	2	3	4	3	2	1	4	3	3	3	2	3	1	1	3	2	4	2	1	2	1	3	3	1	1	1	4	2	3	2
20		2	4	3	3	3	2	1	1	1	4	1	3	3	1	1	2	2	3	1	1	3	4	4	2	2	4	3	1	1	1	1	4	2	3	2
21		1	2	3	1	3	2	3	1	3	3	2	1	1	1	2	4	1	3	1	2	3	4	3	4	1	1	3	3	4	3	1	2	3	4	4
22		1	4	3	2	3	2	1	3	1	4	4	1	3	1	3	2	2	2	1	1	3	4	4	1	3	4	3	4	1	2	1	4	2	3	3
23		2	4	3	2	3	2	1	3	1	2	1	4	2	2	3	2	2	2	1	3	2	4	3	1	2	4	3	1	3	3	1	4	2	3	2
24		2	4	3	3	1	2	2	3	3	2	1	3	2	2	3	2	4	1	1	4	4	4	3	2	2	4	3	2	4	2	1	4	2	3	3
25		1	4	3	2	3	2	2	2	1	2	1	3	2	2	1	2	2	1	1	1	3	2	3	1	2	4	3	1	1	1	1	4	2	3	3
26		2	3	3	2	3	2	2	3	1	2	1	2	1	2	1	2	4	1	1	3	1	4	3	2	2	4	3	2	4	3	1	4	2	3	2

MATHEMATICS TEST SPREADSHEET (APPENDIX D4)

NAME OF SCHOOL: SCHOOL C

STATEMENTS																																				
ALGEBRA										TRIGONOMETRY										ANALYTICAL GEOMETRY					TRANSFORMATION GEOMETRY					DATA HANDLING				SURFACE AREA & VOLUME		
LEARNERS' RESPONSES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
MEMO	2	4	3	3	3	2	1	3	2	2	1	4	2	2	2	2	3	1	1	3	2	4	3	1	2	4	3	1	3	2	1	4	2	3	2	
1	2	3	2	1	1	2	1	4	2	1	1	3	3	4	3	4	3	1	1	3	1	3	1	1	4	1	3	3	3	2	1	4	3	2	3	
2	1	2	3	3	3	2	1	2	2	1	2	3	4	2	3	4	1	3	1	2	1	2	3	1	3	4	3	1	1	2	1	4	2	3	3	
3	1	1	3	2	3	2	3	2	2	1	2	1	4	2	1	4	2	1	1	2	4	2	3	1	3	4	3	1	1	2	1	4	2	3	4	
4	1	2	3	2	1	2	1	2	1	1	2	3	4	2	1	4	3	1	1	1	3	4	3	1	3	4	3	1	1	2	1	4	2	3	4	
5	1	4	3	3	1	2	2	1	3	1	2	3	1	2	2	2	4	3	1	1	4	4	2	1	3	2	2	2	4	2	1	4	2	2	1	
6	1	4	3	3	3	2	2	3	3	1	2	4	4	3	2	2	4	1	1	1	1	4	2	3	3	4	2	2	2	2	1	4	2	2	4	
7	3	4	3	3	4	2	2	2	3	2	1	3	1	1	4	2	1	1	1	1	3	4	2	1	2	2	3	3	4	1	1	2	2	3	2	
8	3	1	2	3	3	1	2	4	2	1	1	1	1	2	1	4	1	3	1	4	1	4	3	1	2	2	1	3	1	2	1	4	2	3	2	
9	1	4	3	3	1	2	2	1	1	3	3	3	2	3	3	4	3	2	1	2	1	4	1	4	3	4	3	3	2	2	4	4	2	3	3	
10	1	4	2	3	1	2	1	2	2	1	2	3	1	2	4	2	3	1	1	1	4	4	1	1	3	4	3	2	4	2	1	4	2	3	4	
11	2	4	3	4	1	2	3	4	2	1	1	1	2	2	3	1	2	1	1	3	2	2	4	1	2	4	3	1	1	2	1	4	2	3	1	
12	2	1	3	1	1	2	2	1	2	1	1	3	2	2	1	2	1	1	1	1	3	2	4	1	3	4	3	1	4	2	1	4	2	3	1	
13	2	1	3	3	3	2	1	3	4	1	1	1	1	2	2	2	1	3	1	3	4	2	3	4	2	4	3	1	4	2	1	4	2	3	2	
14	2	4	2	3	1	2	1	3	2	1	3	1	4	3	4	2	1	1	1	3	4	4	4	3	3	2	4	3	1	4	2	3	4	2	3	4
15	2	3	3	3	3	2	1	1	2	4	1	3	2	2	4	2	1	3	1	1	1	1	4	2	2	4	3	2	2	3	1	4	2	3	2	
16	2	3	3	3	1	2	1	4	2	1	1	3	2	2	3	4	3	3	1	2	2	3	3	3	3	2	2	3	4	2	1	4	2	3	2	
17	2	4	3	2	3	2	1	3	4	1	1	4	2	2	1	2	1	1	1	3	2	4	3	1	2	4	3	1	4	2	1	4	2	3	3	
18	2	1	3	3	4	2	3	3	1	4	1	1	4	2	4	2	3	1	3	4	2	1	3	3	4	3	4	3	1	4	2	4	4	2	3	2
19	1	2	2	1	3	4	1	3	2	4	4	3	1	1	4	2	2	2	1	1	3	4	3	1	1	4	3	3	1	2	1	4	2	3	1	
20	2	2	3	3	2	2	1	3	3	1	3	3	3	2	3	2	3	3	1	3	3	1	3	1	2	3	3	3	4	4	2	4	4	3	1	
21	1	2	3	3	3	1	2	1	2	1	3	1	1	2	4	2	3	2	1	4	2	2	3	3	2	2	2	3	4	2	1	4	2	3	1	
22	2	4	3	3	3	3	2	1	3	1	1	3	2	2	2	3	3	1	1	3	1	1	3	1	3	2	3	1	4	2	1	4	2	4	4	
23	2	4	3	3	3	2	2	3	3	1	1	3	3	2	3	2	3	1	1	3	1	1	1	3	4	3	3	1	4	2	1	4	2	3	1	
24	2	4	3	3	3	2	2	3	3	1	1	3	1	4	1	3	3	1	1	4	1	1	3	3	1	1	3	3	4	2	4	4	2	3	2	
25	1	2	3	3	3	2	3	2	3	1	2	3	1	2	1	4	1	2	1	4	1	1	1	1	2	4	3	1	4	2	1	3	1	3	2	
26	2	2	3	3	1	4	2	4	4	1	1	3	2	2	1	4	4	3	1	2	1	1	3	3	2	4	3	2	4	2	1	4	2	3	2	
27	2	4	2	2	3	2	1	1	3	1	1	1	4	2	1	2	1	3	1	2	4	2	3	1	1	4	3	1	4	2	1	2	2	3	3	
28	2	3	3	3	2	2	1	2	4	1	2	3	2	2	1	2	1	3	1	4	4	3	3	1	2	4	3	1	4	2	4	4	2	3	4	
29	1	1	3	3	1	2	1	3	4	1	1	1	1	2	1	1	4	3	1	3	3	1	3	1	2	4	3	3	4	2	1	4	3	3	1	
30	1	4	3	3	1	2	1	2	2	4	1	3	1	2	1	4	1	4	1	4	1	3	3	4	2	2	3	3	4	2	1	4	2	3	3	
31	2	4	3	2	1	4	2	3	2	1	4	3	4	2	3	1	2	3	1	3	2	1	3	1	3	4	3	2	4	2	1	4	2	3	2	
32	1	4	3	1	2	2	2	3	2	1	3	2	4	1	1	2	2	1	1	3	2	2	3	1	2	4	2	1	4	2	2	4	4	3	2	
33	1	3	3	3	3	2	2	4	2	1	1	3	4	2	4	2	1	1	1	3	3	3	3	1	1	4	2	4	4	2	4	4	2	2	2	
34	4	4	3	3	1	1	2	1	2	1	1	3	2	2	4	1	4	2	1	3	1	1	1	3	4	3	3	4	3	1	4	3	3	4		
35	2	4	3	3	3	3	1	2	3	1	1	3	3	3	1	2	1	1	1	1	3	3	3	1	3	1	2	4	4	2	1	4	2	3	1	
36	2	4	3	3	3	2	2	3	3	1	1	3	2	2	4	4	1	1	1	4	4	4	3	1	2	4	3	3	1	2	1	4	2	3	1	
37	2	4	3	3	3	2	1	1	2	1	1	1	2	2	4	2	1	4	1	3	4	2	3	1	2	4	4	4	4	2	1	4	2	3	4	
38	2	4	3	3	3	2	3	3	2	1	2	3	2	2	3	3	1	2	1	4	3	2	1	3	4	3	3	4	2	3	4	2	3	4	2	3
39	1	3	3	3	3	2	2	3	2	1	3	4	2	1	4	3	2	3	1	3	2	2	3	1	2	4	2	1	4	2	1	4	4	2	4	
40	2	4	3	3	1	2	2	3	2	1	3	4	2	2	3	2	3	2	1	2	3	2	2	1	2	4	3	3	4	1	1	4	3	3	1	
41	2	4	3	3	4	2	1	3	2	1	1	4	2	2	4	2	1	1	1	3	4	3	3	1	3	4	3	4	1	2	1	4	4	3	1	
42	2	4	3	3	3	2	1	3	2	2	1	4	2	2	2	2	3	1	1	3	2	4	3	1	2	4	3	1	1	2	1	4	2	3	2	
43	2	4	3	3	3	2	1	2	1	2	4	4	2	2	2	2	3	1	1	3	2	4	3	1	2	4	3	1	3	2	1	4	2	3	2	
44	3	4	3	4	1	2	4	2	2	2	2	1	3	2	3	2	4	2	1	3	2	4	1	4	2	4	3	3	3	2	1	4	2	3	4	
45	1	2	3	2	3	1	2	3	4	1	3	3	2	1	4	2	3	3	1	2	2	4	1	2	4	4	3	2	4	2	1	4	1	3	3	
46	2	4	3	3	3	2	1	4	2	1	1	1	2	2	2	2	1	1	1	2	2	4	3	1	3	4	3	1	1	2	3	4	2	3	3	
47	2	3	3	3	3	2	3	2	2	1	1	4	2	2	4	2	3	3	1	3	2	4	1	1	1	4	3	4	4	2	1	4	3	3	3	
48	2	4	3	3	3	2	1	1	2	1	1	1	2	2	2	2	1	1	1	2	4	2	3	1	2	4	3	1	1	2	1	4	2	3	2	
49	2	4	3	3	3	1	2	3	2	1	4	3	2	2	1	1	3	2	1	4	2	1	2	3	4	2	2	1	4	2	1	1	4	3	2	
50	1	1	3	3	4	2	1	1	2	4	3	3	2	2	2	1	2	1	3	2	3	3	1	3	4	3	3	4	2	2	4	2	3	3	3	
51	1	4	3	3	3	2	1	3	2	4	1	3	2	2	4	2	1	1	1	3	2	4	3	1	2	4	3	1	3	2	1	4	2	3	2	

APPENDIX E: MATHEMATICS TEST - MARKING MEMORANDUM

NO.	CORRECT STATEMENT
1.	2
2.	4
3.	3
4.	3
5.	3
6.	2
7.	1
8.	3
9.	2
10.	2
11.	1
12.	4
13.	2
14.	2
15.	2
16.	2
17.	3
18.	1
19.	1
20.	3
21.	2
22.	4
23.	3
24.	1
25.	2
26.	4
27.	1
28.	1
29.	3
30.	2
31.	1
32.	4
33.	2
34.	3
35.	2

MAXIMUM MARKS: 35

APPENDIX F: APPROVAL LETTER FOR MATHEMATICS TEST



PORT ELIZABETH DISTRICT OFFICE

☒ Private Bag X3931* North End *PE* 6056
FET/CURRICULUM MANAGEMENT & SUPPORT

**DEPARTMENT OF EDUCATION
PROVINCE OF THE EASTERN CAPE**

FROM THE DESK OF MR. C.F. HERADIEN

To: Mr. W.W. Hendricks
NMMU
PhD (Education)
Student number: 202345297
6 June 2011

ANALYSIS OF MATHEMATICS TEST

The following table is an analysis of the LOs and ASs covered in the test.

STATEMENT	LEARNING OUTCOMES AND ASSESSMENT STANDARDS	COMPLETE LIST OF LOs AND ASs IN GRADE 11	TICK(✓) INDICATE COVERED
Statement 1	11.2.2	11.1.1	(✓) indirectly
Statement 2	11.2.5	11.1.2	✓
Statement 3	11.1.3	10.1.3 & 11.1.3	✓✓
Statement 4	10.1.4 & 11.1.4	10.1.4 & 11.1.4	✓✓
Statement 5	11.2.3	11.1.5	✓
Statement 6	11.3.3	11.1.6	
Statement 7	11.1.2	11.2.1	
Statement 8	11.2.5(a)	10.2.2 & 11.2.2	✓✓✓✓
Statement 9	11.2.2	11.2.3	✓✓
Statement 10	12.1.3 (optional)	11.2.4	
Statement 11	11.2.3(a)	11.2.5	✓✓
Statement 12	11.1.5	11.2.6	
Statement 13	10.1.3 & 11.1.3	11.2.7	
Statement 14	11.1.4	11.2.8	
Statement 15	12.2.8	11.3.1	✓
Statement 16	11.3.5(b)	10.3.3 & 11.3.3	✓✓✓✓✓
Statement 17	11.3.5(c)	10.3.4 & 11.3.4	✓✓
Statement 18	10.3.5	10.3.5 & 11.3.5	✓✓✓✓✓✓✓
Statement 19	11.3.5(b)	11.3.6	
Statement 20	11.3.5(d)	11.3.7	Not to be examined
Statement 21	11.3.5(c)	10.4.1 & 11.4.1	✓✓✓✓
Statement 22	10.2.2 & 11.2.2		
Statement 23	10.3.3 & 11.3.3	12.1.3(optional)	✓

Statement 24	11.3.3
Statement 27	11.3.5(a)
Statement 28	12.2.2
Statement 29	10.3.4(b) & 11.3.4(b)
Statement 30	10.3.4(a)
Statement 31	11.4.1(a)
Statement 32	10.4.1(a)
Statement 33	11.4.1(a)
Statement 34	11.4.1(a)
Statement 35	11.3.1

12.2.2	✓
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Note the following:

- Most of the LOs and ASs has been covered in the test.
- It is clear however that some have not been covered.
- 11.3.3 and 11.3.5 seem to be over tested, but these are large sections, examples such as Functions and Trigonometry.
- Also take note that Statements 10 and 28 are only covered in Grade 12, but could be regarded as level 4 (problem solving) questions for this test.
- Effect corrections and changes as indicated.

Recommendations/Corrections/Changes

- In Statement 14 the 16% should read 18% in order to concur with Memorandum.
- In Statement 15 the answer should be (b) - $\frac{2}{3}$.
- In Statement 18 the degrees (°) for the interval is missing.
- Also correct Statement 35: It should read: If the volume of a cone is given as $V = \frac{1}{3} \times A \times h$, where A is the area of the base and h is the height of the cone.

Taking the above comments into consideration and making a few changes I would say that the test complies in most respects.

The test is conditionally approved on condition that the above recommendations, corrections and changes are implemented.

Not to be re-submitted for further moderation.

Hope my contribution would help.

 ...

SES: MATHEMATICS (FET)

APPENDIX G: APPROVAL LETTER FROM HEAD OFFICE TO CONDUCT RESEARCH



Province of the
EASTERN CAPE
EDUCATION

STRATEGIC PLANNING POLICY RESEARCH AND SECRETARIAT SERVICES
Steve Vukile Tshwete Complex • Zone 6 • Zwelitsha • Eastern Cape
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Enquiries: Dr Heckroodt

Email: bernetia@iafrica.com

Winston Hendricks
63 Greenpoint Road
Buffalo Flats
EAST LONDON
5201
27 July 2011

Dear Mr WW Hendricks

PERMISSION TO UNDERTAKE DOCTORAL THESIS: THE EFFECT OF COLLECTIVE EFFICACY ON THE INTRODUCTION OF A NEW CURRICULUM BY MATHEMATICS TEACHERS

1. Thank you for your application to conduct research.
2. Your application to conduct the above mentioned research in three (3) Secondary Schools , that is, Greenpoint, Mzokhanyo and East London Secondary School in the Eastern Cape under the jurisdiction of the East London District is hereby approved on condition that:
 - a. there will be no financial implications for the Department;
 - b. institutions and respondents must not be identifiable in any way from the results of the investigation;
 - c. you present a copy of the written approval letter of the Eastern Cape Department of Education (ECDoE) to the District Directors before any research is undertaken at any institutions within that particular district;
 - d. you will make all the arrangements concerning your research;



- e. the research may not be conducted during official contact time, as educators' programmes should not be interrupted;
- f. should you wish to extend the period of research after approval has been granted, an application to do this must be directed to the Director: Strategic Planning Policy Research and Secretarial Services;
- g. the research may not be conducted during the fourth school term, except in cases where a special well motivated request is received;
- h. your research will be limited to those schools or institutions for which approval has been granted;
- i. you present the Department with a copy of your final paper/report/dissertation/thesis free of charge in hard copy and electronic format. This must be accompanied by a separate synopsis (maximum 2 – 3 typed pages) of the most important findings and recommendations if it does not already contain a synopsis. This must also be in an electronic format.
- j. you are requested to provide the above to the Director: The Strategic Planning Policy Research and Secretarial Services upon completion of your research.
- k. you comply to all the requirements as completed in the Terms and Conditions to conduct Research in the ECDE document duly completed by you.
- l. you comply with your ethical undertaking (commitment form).
- m. You submit on a six monthly basis, from the date of permission of the research, concise reports to the Director: Strategic Planning Policy Research and Secretariat Services.

3. The Department wishes you well in your undertaking. You can contact the Director, Dr. Annetia Heckroodt on 043 702 7428 or mobile number 083 271 0715 and email: annetia.heckroodt@edu.ecprov.gov.za should you need any assistance.


Dr AS Heckroodt
Director: Strategic Planning Policy Research and Secretariat Services



**APPENDIX H: APPROVAL LETTER FROM THE DISTRICT OFFICE TO
CONDUCT RESEARCH**



Province of the
EASTERN CAPE

**DEPARTMENT OF EDUCATION
EAST LONDON DISTRICT**

Dr. WB Rubusana Building * NU 1 Mdantsane* Private Bag X9007 * East London * 5200 * REPUBLIC OF SOUTH AFRICA * Tel: +27 (0)43 708 6208 Fax: +27 (0)43 760 0545 *Website: ecprov.gov.za

Date: 03 October 2011

ENQUIRIES: MRS A C ESBEN

Mr Winston Hendricks
63 Greenpoint Road
Buffalo Flats
EAST LONDON
5209

Dear Sir

**PERMISSION TO UNDERTAKE DOCTORAL THESIS: THE EFFECT OF
COLLECTIVE EFFICACY ON THE INTRODUCTION OF A NEW CURRICULUM BY
MATHEMATICS TEACHERS**

Your letter on the abovementioned matter has reference.

Permission is hereby granted for you to conduct the abovementioned research in three secondary schools in the East London District, ie Greenpoint, Mzokhanyo and East London Secondary School.

This permission is granted on condition that tuition time is not disrupted and that you obtain the necessary permission from the school principals as well.

We wish you well in your endeavours.

Yours faithfully


W M NGWANYA
DISTRICT DIRECTOR

APPENDIX I: ETHICS CLEARANCE LETTER FROM NMMU



**Nelson Mandela
Metropolitan
University**

for tomorrow

• PO Box 77000 • Nelson Mandela Metropolitan University -
• Port Elizabeth • 6031 • South Africa • www.nmmu.ac.za

FACULTY OF EDUCATION

Tel. +27 (0)41 504 2125
Fax. +27 (0)41 504 9383

29 September 2011
Mr WW Hendricks / Prof Botha
Education Faculty
NMMU

Dear Mr Hendricks / Prof Botha

THE EFFECT OF COLLECTIVE EFFICACY ON MATHEMATICS TEACHERS INTRODUCING A NEW CURRICULUM IN MATHEMATICS

Your above-entitled application for ethics approval was approved by the Faculty Research, Technology and Innovation Committee of Education (ERTIC) meeting on 15 June 2011.

We take pleasure in informing you that the application was approved by the Committee.

The ethics clearance reference number is **H11-EDU-ERE-032**.

We wish you well with the project. Please inform your co-investigators of the outcome, and convey our best wishes.

Yours sincerely

A handwritten signature in black ink, appearing to read 'J Elliott-Gentry'.

Ms J Elliott-Gentry
Secretary: ERTIC